NATIONAL ANTIMICROBIAL
RESISTANCE COMMITTEE

وزارة الصحة
Ministry of Health
الإدارة العامة للرعاية الصيدلية
General Administration
of Pharmaceutical Care

# National Antimicrobial Therapy Guidelines for Community and Hospital Acquired Infections in Adults

Prepared by the Antimicrobial Stewardship Subcommittee of the National Antimicrobial Resistance Committee and the General Administration of Pharmaceutical Care at Ministry of Health

***Preface***

*This is the 2018 edition of the antimicrobial guidelines prepared by antimicrobial stewardship technical subcommittee under National Antimicrobial Resistance committee (AMR). The current edition is aimed at guiding physicians who practice across different levels of healthcare acuity to select appropriate empirical antibiotics for treatment of common community & healthcare associated infections. Guidelines are considered supplementary strategy of antimicrobial stewardship and is most helpful in hospitals who lack infectious diseases expertise or stewardship team. I would like to thank all members that contributed to this document and the general administration of pharmaceutical care for its support.*

***Dr. Hail Al Abdely,***
***Chairman - National Antimicrobial Resistance Committee***

***Acknowledgment***

*We are proud to introduce the 2018 edition of the adult antimicrobial therapeutic guidelines to provide physicians with reliable, up-to-date guidance for the management of common adult infectious diseases.*

*This manual is prepared by a group of experts in the field of infectious diseases medicine, infectious diseases/clinical pharmacy, and infection control. The empiric therapeutic options were selected based on the best available evidence and local epidemiology of antimicrobial resistance. We hope these guidelines will help streamline practice and minimize misuse of antimicrobial drugs to support the national antimicrobial stewardship initiative.*

*My sincere appreciation to the great team who worked hard to update the current edition:*
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***Chairperson of Antimicrobial Stewardship Technical subcommittee***

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# National Antimicrobial Guidelines for Community-Acquired Infections in Adults

| | |
|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐☐<br>NAME: _____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY: _____<br>WEIGHT (ACTUAL/ESTIMATED) _____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***Antibiotics order (Group A Streptococcal Pharyngitis)***

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

**The modified Centor criteria**

| | |
|---|---|
| Absence of a cough, rhinorrhea, hoarseness and oral ulcer | One point is given for each of the criteria |
| Swollen and tender cervical lymph nodes | |
| Temperature >38.0 °C (100.4 °F) | |
| Tonsillar exudate or swelling | |
| Age less than 15years (a point is subtracted if age >44 years) | |

| | |
|---|---|
| 0 or 1 point | No antibiotic or culture needed |
| 2-3 points | Antibiotic based on culture or RADT* |
| >3 points | Empiric antibiotics |

* Negative rapid antigen detection test (RADT) tests should be backed up by a throat culture (strong, high). Positive RADTs do not necessitate a back-up culture because they are highly specific (strong, high)
* Routine use of back-up throat cultures for those with a negative RADT is not necessary for adults in usual circumstances, because of the low incidence of GAS pharyngitis in adults

**Empiric Therapy for (GAS) Pharyngitis** (for renal failure patient see appendix)

| **Patient group** | **Therapy (dosing interval in hours)- Duration** | |
|---|---|---|
| **Condition** | **First line** | **Alternative** |
| No penicillin allergy | ❒ Penicillin V, PO 500 mg q12hr for 10 days | 1❒ Amoxicillin, PO 500 mg q12hr for 10 days **OR**<br>2❒ penicillin G Benzathine, IM 1.2 million units single dose |
| Penicillin allergy | ❒ Cephalexin PO 500 mg q12hr for 10 days (only for non-immediate-type and non-severe hypersensitivity reactions to penicillin) | 1❒ Clindamycin PO 300 mg q8hr for 10 days **OR**<br>2❒ Azithromycin PO 500 mg q24hr for 5 days **OR**<br>3❒ Clarithromycin PO 250 mg q12hr for 10 days |

Physician Name: _____ pager/ mobile: _____
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Nurse name: _____ Nurse signature: _____
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Physician/Pharmacist note:
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Shulman, ST; Bisno, AL; Clegg, HW; Gerber, MA; Kaplan, EL; Lee, G; Martin, JM; Van Beneden, C (Sep 9, 2012). "Clinical Practice Guideline for the Diagnosis and Management of Group A Streptococcal Pharyngitis: 2012 Update by the Infectious Diseases Society of America.". *Clinical infectious diseases: an official publication of the Infectious Diseases Society of America* **55** (10): e86–102

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***Antibiotics order (Acute Bacterial Rhinosinusitis)***

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

IDSA recommends that any of the 3 following clinical presentations be used to identify patients with acute bacterial vs. viral rhinosinusitis:

- Symptoms or signs persistent & not improving for ≥10 days
- *Severe* symptoms or signs for at least 3–4 days
- *Worsening* symptoms or signs OR "double sickening" for lasted 5–6 days and were initially improving)

**Empiric Therapy for Acute Bacterial Rhinosinusitis** (for renal failure patient appendix)

| Severity | First line | Alternative |
|---|---|---|
| Mild cases | ❒ Amoxycillin-Clavulanate 1000mg PO q12hr 5-7 days | ❒ Cefuroxime axetil 500 mg PO q12hr for 5-7 days (Only if non-immediate-type and non-severe hypersensitivity reactions to penicillins)<br>**OR**<br>❒ Doxycycline 100 mg PO q12hr for 5-7 days |
| Severe infection requiring hospitalization | ❒ Amoxycillin-Clavulanate IV 1g q8 hr for 5-7 days | ❒ Ceftriaxone 1–2 g IV q24 hr for 5-7 days (Only if non-immediate-type and non-severe hypersensitivity reactions to penicillins) **OR**<br>❒ Levofloxacin 500 mg PO/IV q24hr for 5-7 days (if immediate-type or severe hypersensitivity reaction to beta-lactams) |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:

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Chow, AW; Benninger, MS; Brook, I; Brozek. "IDSA clinical practice guideline for acute bacterial rhinosinusitis in children and adults". *Clin infect dis 2012* **;54** (8): e72–e112

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## *Infective Endocarditis*

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

Microbiology:
-Three to five blood cultures of at least 10 mL each should be drawn during the first 24–48 hours.

**Therapy for Infective Endocarditis** (for renal failure patient, see appendix)

**❒ Native Valve**

| Patient group | Therapy (dosing interval in hours) (weeks) |
|---|---|
| Empiric therapy<br>(If patient is not acutely ill and not in heart failure, the preference is to wait for blood culture results) | ❒ Vancomycin IV 15 mg/kg q12hr (2wks) PLUS<br>❒ Ceftriaxone IV/IM 2g q24h (2wks) **OR**<br><br>❒ Vancomycin IV 15 mg/kg q12hr (2wks) PLUS<br>❒ Gentamicin 3 mg/kg IV q24h (2wks) |
| *Streptococcus viridans*<br>(Penicillin MIC ≤ 0.12) | ❒ Penicillin G IV 2-3 million Unit q4h (4wks) **OR**<br>❒ Penicillin G IV 2-3 million Unit q4h PLUS<br>❒ Gentamicin 3 mg/kg IV q24h (2wks)<br><br>**In patients with non-immediate and non-severe penicillin allergy:**<br>❒ Ceftriaxone IV/IM 2g q24 hr (4wks) **OR**<br>❒ Ceftriaxone IV 2 g q24hr PLUS<br>❒ Gentamicin 3 mg/kg IV q8h (2wks)<br>**In patients with immediate or severe penicillin allergy:**<br>❒ Vancomycin 15mg/kg q12h (4wks) |
| Streptococcus viridans<br>(Penicillin MIC: 0.12 - <0.5) | ❒ Penicillin G: IV 4 million Unit q4h (4wks) PLUS<br>❒ Gentamicin 3mg/kg q24h IV/IM (2wks)<br><br>**In patients with non-immediate and non-severe penicillin allergy:**<br>❒ Ceftriaxone IV 2 g q24h PLUS (2wks)<br>❒ Gentamicin 3 mg/kg q24h IV/IM (2wks)<br>**In patients with immediate or severe penicillin allergy:**<br>Vancomycin 15mg/kg q12h (4wks) |
| Streptococcus viridans<br>(Penicillin MIC > 0.12) | **If ceftriaxone-susceptible:**<br>❒ Ceftriaxone IV 2 g q24h (4wks) PLUS<br>❒ Gentamicin 3 mg/kg q24h IV/IM (4wks)<br>**If ceftriaxone-resistant:**<br>❒ Vancomycin 15mg/kg q12h (4wks) |
| Staphylococcus<br>methicillin **sensitive** | ❒ Cloxacillin IV 2 g q4hr (6wks) OR<br>❒ Flucloxacillin IV 2g q4hr (6wks)<br>**In patients with non-immediate and non-severe penicillin allergy:**<br>❒ Cefazolin IV 2 g q8hr (6wks)<br>**In patients with immediate or severe penicillin allergy:**<br>❒ Vancomycin 15mg/kg q12h (6wks) |
| Staphylococcus<br>methicillin **resistant** | ❒ Vancomycin IV 15mg/kg q12hr (6wks) |

| | |
|---|---|
| Enterococcus—<br>Penicillin sensitive | ❒ Ampicillin IV 2g q4h (4-6 wks) PLUS<br>❒ Gentamicin 1 mg/kg q8hr IV/IM (4-6 wks) **OR**<br>❒ Penicillin G IV 3-5 million Unit q4h (4-6wks) PLUS<br>❒ Gentamicin 1mg/kg q8hr IV/IM (4-6wks)<br>**If CrCl<50mL/min:**<br>❒ Ampicillin IV 2g q4h (6wks) PLUS<br>❒ Ceftriaxone 2g q12hr IV (6wks) |
| Enterococcus—<br>penicillin resistant or penicillin allergy | ❒ Vancomycin IV15mg/kg q12hr PLUS<br>❒ Gentamicin 1 mg/kg q8hr IV (6wks) |
| *Gentamicin resistance (MIC > 500 µg/mL)*:<br>(Penicillin sensitive) | ❒ Ampicillin IV 2g q4h (6wks) PLUS<br>❒ Ceftriaxone 2g q12hr IV (6wks)<br>**If Streptomycin-susceptible** :<br>❒ Ampicillin IV 2g q4hr PLUS<br>❒ Streptomycin 15 mg/kg IV q12hr (6wks) **OR**<br>❒ Penicillin-G IV 3-5 million-unit q4h (4-6 weeks) PLUS<br>❒ Streptomycin IV/IM 15 mg/kg q12hr (6 weeks) |
| Enterococcus penicillin, aminoglycoside, and vancomycin resistant | ❒ Daptomycin 10-12mg/kg q24hr (>6wks) **OR**<br>❒ Linezolid IV 600 mg q12hr (>6wks) |
| HACEK group | ❒ Ceftriaxone IV 2g q24 h (4wks) **OR**<br>❒ Ampicillin IV 2g q4h (4wks) **OR**<br>❒ Ciprofloxacin IV 400 mg q12h (4wks) **OR**<br>❒ Ciprofloxacin PO 500mg q12h (4wks) |

**❒ Prosthetic valve**

| Patient group | Therapy (dosing interval in hours) (weeks) |
|---|---|
| Empiric therapy | ❒ Vancomycin IV 15 mg/kg q12hr (6wks) PLUS<br>❒ Gentamicin IV 3 mg/kg q24hr (6wks) PLUS<br>❒ Rifampin 300 mg PO/IV q8h (6wk) |
| *Streptococcus viridans*<br>(Penicillin MIC < 0.5) | ❒ Penicillin G IV 4 million Unit q4 h (6wk) PLUS<br>❒ Gentamicin IV 3mg/kg q24hr (6wk)<br>**In patients with non-immediate and non-severe penicillin allergy:**<br>❒ Ceftriaxone 2 g q24 h IV (6wk) PLUS<br>❒ Gentamicin IV 3mg/kg q24hr (6wk)<br>**In patients with immediate or severe penicillin allergy:**<br>❒ Vancomycin 15mg/kg q12h (6wks) |
| *Streptococcus viridans*<br>(Penicillin MIC > 0.5) | **If ceftriaxone-susceptible:**<br>❒ Ceftriaxone IV 2 g q24h (6wks) PLUS<br>❒ Gentamicin 3 mg/kg q24h IV/IM (6wks)<br>**If ceftriaxone-resistant:**<br>❒ Vancomycin 15mg/kg q12h (6wks) |
| Staphylococcus—<br>methicillin sensitive | ❒ Cloxacillin IV 2g q4hr (≥6wks) PLUS<br>❒ Gentamicin IV 1mg/kg q8h (2wks) PLUS<br>❒ Rifampin IV/PO 300mg q8h (≥6wks) **OR**<br>❒ Flucloxacillin IV 2g q4hr (≥6wks) PLUS<br>❒ Gentamicin IV 1mg/kg q8h (2wks) PLUS<br>❒ Rifampin IV/PO 300mg q8hr (≥6wks)<br>**In patients with non-immediate or non-severe penicillin allergy:**<br>❒ Cefazolin IV 2g q8hr (≥6wks) PLUS<br>❒ Gentamicin 1mg/kg q8hr IV (2wks) PLUS<br>❒ Rifampin IV/PO 300mg q8hr (≥6wks)<br>**In patients with immediate or severe penicillin allergy:**<br>❒ Vancomycin 15mg/kg q12h (≥6wks) PLUS<br>❒ Gentamicin 1mg/kg q8hr IV (2wks) PLUS<br>❒ Rifampin IV/PO 300mg q8hr (≥6wks) |
| Staphylococcus—<br>methicillin resistant (MRSA) | ❒ Vancomycin 15mg/kg q12h (≥6wks) PLUS<br>❒ Gentamicin 1mg/kg q8hr IV (2wks) PLUS<br>❒ Rifampin IV/PO 300mg q8hr (≥6wks) |

| | |
|---|---|
| Enterococcus—<br>Penicillin sensitive | ❒ Ampicillin IV 2g q4h (4-6 wks) PLUS<br>❒ Gentamicin 1 mg/kg q8hr IV (4-6 wks) **OR**<br>❒ Penicillin G: IV 3-5 million Unit q4h (4-6wks) PLUS<br>❒ Gentamicin 1mg/kg q8hr IV (4-6wks)<br>**If CrCl<50mL/min:**<br>❒ Ampicillin IV 2g q4h (6wks) PLUS<br>❒ Ceftriaxone 2g q12hr IV (6wks) |
| Enterococcus—<br>penicillin resistant or penicillin allergy | ❒ Vancomycin IV15mg/kg q12hr + Gentamicin 1mg/kg q8hr IV (6wks) |
| *Gentamicin resistance (MIC > 500 µg/mL)*:<br>(Penicillin sensitive) | ❒ Ampicillin IV 2g q4h (6wks) PLUS<br>❒ Ceftriaxone 2g q12hr IV (6wks)<br>**If Streptomycin-susceptible** :<br>❒ Ampicillin IV 2g q4hr PLUS<br>❒ Streptomycin 15 mg/kg IV q12hr (6wks) **OR**<br>❒ Penicillin-G IV 3-5 million-unit q4h (4-6 weeks) PLUS<br>❒ Streptomycin IV 15 mg/kg q12hr (6 weeks) |
| Enterococcus penicillin, aminoglycoside, and vancomycin resistant | ❒ Daptomycin 10-12mg/kg q24hr (>6wks) **OR**<br>❒ Linezolid IV 600 mg q12hr (>6wks) |
| HACEK group | ❒ Ceftriaxone IV/IM 2g q24 h (6wks)<br>❒ Ampicillin IV 2g q4h (6wks)<br>❒ Ciprofloxacin IV 400 mg q12h (6wks) **OR**<br>❒ Ciprofloxacin PO 500mg q12h (6wks) |
| Endocarditis prevention | **a. I.E prophylaxis is indicated *only* for high-risk cardiac conditions such as:**<br>- Prosthetic material used for cardiac valve repair<br>- A prior history of IE<br>- Unrepaired cyanotic congenital heart disease, including palliative shunts and conduits<br>- Completely repaired congenital heart defects with prosthetic material or device during the first six months after the procedure (whether placed by surgery or by catheter intervention).<br>- Repaired congenital heart disease with residual defects at the site or adjacent to site of the prosthetic device<br>- Cardiac "valvulopathy" in a transplanted heart. Valvulopathy is defined as documentation of substantial leaflet pathology and regurgitation.<br><br>*Routine dental cleaning or routine anaesthetic injections through non-infected tissue does not require antibiotic prophylaxis.*<br>**The risk of IE is highest for the following dental procedures hence prophylaxis is indicated:**<br>Those involving manipulation of gingival tissue or<br>The peri-apical region of the teeth or<br>Perforation of the oral mucosa, such as tooth extractions or<br>Drainage of a dental abscess<br>Prosthetic heart valves, including bioprosthetic and homograft valves<br><br>❒ Amoxicillin 2 g PO one hour before procedure **OR**<br>❒ Ampicillin 2 g IM/IV 30 min before procedure<br>**Penicillin allergy:**<br>❒ Cefazolin 1g IV/IM 30 min before procedure |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:
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Baddour LM, Wilson WR, Bayer AS, et al. Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications. A scientific Statement for Healthcare Professionals from the American Heart Association. Circulation 2015;132:1435-86.
Wilson W, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis. Guidelines from the American Heart Association. Circulation 2007;115:1656–8.

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| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐☐<br>NAME: _____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY: _____<br>WEIGHT (ACTUAL/ESTIMATED) _____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

## *Osteomyelitis*

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

**Therapy for Osteomyelitis** (for renal failure patient appendix)

| Patient Subtype | Likely Infecting Organism | Antibiotic | Duration |
|---|---|---|---|
| Adults | **MSSA** | ❒ Cloxacillin IV 1.5-2g q4-6hr **OR**<br>❒ Flucloxacillin sodium IV 1.5-2g q4-6hr **OR**<br>❒ Cefazolin IV 2g q8hr | 6 weeks<br>If signs or symptoms are still present at 6 weeks, therapy should be extended |
| | **MRSA** | ❒ Vancomycin 15-20mg/kg IV q12h **OR**<br>❒ Daptomycin 6-8mg/kg IV q24h **OR**<br>❒ Linezolid 600mg IV/PO q12h | |
| | ***Pseudomonas*** | ❒Ceftazidime 2 gm IV q8h<br>❒Ciprofloxacin 750mg PO q12h | |
| • Submit bone biopsy for histology and culture.<br>• If hemodynamically and neurologically stable, hold antibiotic therapy until causative organism is identified.<br>• Start with IV antibiotics and consider switching after few days of improvement to highly bioavailable oral antibiotics. | | | |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:
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Lew DP, Waldvogel FA. Osteomyelitis. Lancet 2004;364:369–79.
Berbari EF, Kanj SS, Kowlski TJ, et al. 2015 Infectious Disease Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. Clin Infect Dis 2015;61:26-46.

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***Diabetic Foot Infection***

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

**Therapy for Diabetic foot infection** (for renal failure patient, see appendix)

| | **Suspected pathogen** | **Antibiotic Therapy** | **Duration** |
|---|---|---|---|
| Oral agents for empiric treatment of mild to moderate early diabetic foot infections (Outpatient) | Streptococci and Staphylococci (MSSA) | ❒ Cloxacillin 500mg PO q6h **OR**<br>❒ Flucloxacillin 500mg PO q6h **OR**<br>❒ Cephalexin 500mg PO q6h (if non-immediate-type or non-severe hypersensitivity reaction to penicillin) **OR**<br>❒ Amoxicillin-clavulanate PO 1000mg q12h **OR**<br>❒ Clindamycin PO 300-450 mg q6hr (if immediate-type or severe hypersensitivity reaction to beta-lactam) | 7-10 days |
| | Streptococci and MRSA | ❒ Clindamycin PO 300-450mg q6h **OR**<br>❒ Trimethoprim-sulfamethoxazole PO 160/800mg [DS] q12h **OR**<br>❒ Doxycycline PO 100mg q12h | 7-10 days |
| Empiric treatment of moderate (PO or IV agents) to severe (IV agents) diabetic foot infections | Polymicrobial | ❒ Vancomycin IV 15mg/kg q12hr **PLUS**<br>❒ Piperacillin-tazobactam IV 4.5g q6-8hr **OR**<br><br>❒ Vancomycin IV 15mg q12hr **PLUS**<br>❒ Ceftazidime or cefepime IV 2g q8h ±<br>❒ Metronidazole 500mg PO/IV q8h **OR**<br><br>❒ Vancomycin IV 15mg/kg q12h **PLUS**<br>❒ Imipenem-cilastatin IV 500mg q6hr **OR**<br><br>❒ Vancomycin IV 15mg/kg q12h **PLUS**<br>❒ Meropenem IV 1000mg q8hr **OR**<br><br>❒ Ciprofloxacin PO 500-750mg **OR**<br>❒ Ciprofloxacin IV 400mg q12h **PLUS**<br>❒ Clindamycin PO/IV 600mg q8h (if moderate) | 10-14 days And expand the duration depending on clinical symptom progress |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:
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Benjamin A. Lipsky,1 Anthony R. Diagnosis and Treatment of Diabetic Foot infection 2012; 54 : e132 -e173
Uptodate 2014

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## *Skin and Soft Tissue Infection*

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

**Therapy for Purulent Skin and Soft Tissue Infections (Furuncle/Carbuncle/Abscess)**

(For renal failure patients, see Appendix)

| Severity | Empiric Therapy | Duration |
|---|---|---|
| Mild | ❒ Incision and drainage only or with antibiotics in some cases (similarly to moderate cases) | 7–10 days |
| Moderate | ❒ Incision and drainage with:<br>❒ Trimethoprim-sulfamethoxazole PO160/800 mg [DS] q12h<br>❒ Doxycycline PO 100mg q12h | |
| Severe | Incision and drainage with<br>❒ Vancomycin IV 15mg/kg q12h **OR**<br>❒ Linezoild PO 600mg q12hr **OR**<br>❒ Daptomycin IV 4mg/kg q24h | |

**Therapy for non-purulent Skin and Soft Tissue Infections (Necrotizing infection/Cellulitis/Erysipelas)**

| **Severity** | **Empiric Therapy** | **Duration** |
|---|---|---|
| Mild | ❒ Cloxacillin or Flucloxacillin 500mg PO q6h **OR**<br>❒ Cephalexin 500mg PO q6h (if non-immediate-type or non-severe hypersensitivity reaction to penicillin) **OR**<br>❒ Clindamycin PO 300-450 mg q6hr (if immediate-type or severe hypersensitivity reaction to beta-lactam) | 7–10 days |
| Moderate | ❒ Penicillin G 2-4 million units IV q4-6h **OR**<br>❒ Cefazolin 1g IV q8h (if non-immediate-type or non-severe hypersensitivity reaction to penicillin) **OR**<br>❒ Clindamycin 600mg IV q8h (if immediate-type or severe hypersensitivity reaction to beta-lactam) | |
| Severe | ❒ Vancomycin IV 15mg/kg q12hr **PLUS**<br>❒ Piperacillin-tazobactam IV 4.5g q6-8hr **OR**<br>❒ Vancomycin IV 15mg/kg q12h **PLUS**<br>❒ Imipenem-cilastatin IV 500mg q6hr **OR**<br>❒ Vancomycin IV 15mg/kg q12h **PLUS**<br>❒ Meropenem IV 1000mg q8hr **OR**<br>❒ Vancomycin IV 15mg/kg q12h **PLUS**<br>❒ Ciprofloxacin PO 500-750mg **OR**<br>❒ Ciprofloxacin IV 400mg q12h **PLUS**<br>❒ Metronidazole PO/IV 500mg q8h<br>**If necrotizing fasciitis,** also add<br>❒ Clindamycin 600-900mg IV q8h | |

Physician Name: _____ pager/ mobile: _____

Physician signature: _____

Nurse name: _____ Nurse signature: _____

Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:

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Stevens DL, et al. Practice Guidelines for the Diagnosis and Management of Skin and Soft-Tissue Infections. CID 2014:59:10-52.

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***Animal bite & Human bite***

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

(for renal failure patient appendix)

| Patient Groups | Therapy (dosing interval) | Duration |
|---|---|---|
| **Animal or human bite** | ❒ Amoxicillin-clavulanic acid 1000mg PO q12h **OR**<br>❒ Cefuroxime axetil 500mg PO q12h **PLUS**<br>❒ Metronidazole 500mg PO q8h **OR**<br>❒ Doxycycline 100mg PO q12h | 7 days |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:

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Stevens DL, et al. Practice Guidelines for the Diagnosis and Management of Skin and Soft-Tissue Infections. CID 2014:59:10-52.

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## *Community Acquired Pneumonia*

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

CURB-65 Mortality Prediction Tool for Patients with Community-Acquired Pneumonia

| | |
|---|---|
| Confusion | Points (*Assign 1 point for each variable)* |
| Blood urea nitrogen level > 20 mg per dL (7.14 mmol per L) | |
| Respiratory rate ≥ 30 breaths per minute | |
| Blood pressure (systolic < 90 mm Hg or diastolic ≤ 60 mm Hg) | |
| Age ≥ 65 years | |

Inpatient vs Outpatient

| | |
|---|---|
| 0 or 1 point | Treat as outpatient |
| 2 points | Treat as inpatient |
| ≥3 points | Treat in intensive care unit |

Empiric Therapy for Community-Acquired Pneumonia (for renal failure patient see appendix)

| **Patient's condition** | Therapy (dosing interval in hours) patient with normal renal function | |
|---|---|---|
| | **First line** | **Alternative** |
| **Previously healthy outpatients; no antibiotic use in past 3months** | ❒ Azithromycin 500 mg once then 250 mg daily for 4 days | ❒ Doxycycline 100 mg PO q12hr 5 days |
| **Outpatients with comorbidities or antibiotic use in past three months** | ❒ High dose amoxicillin 1 g PO q 8 hrs PLUS<br>❒ Azithromycin 500 mg once then 250 mg daily for 4 days | ❒ Levofloxacin 750 mg PO q24h (B-lactam allergy) for 5 days |
| **Inpatients, non-ICU (In previously healthy young (<65 yrs) patient with no antibiotic use or healthcare setting exposure in the last 3 months)** | ❒ Penicillin G 12 to 24 million unit/day in divided doses every 4 to 6 hours (can be given as 2 million units IV q 4h) PLUS<br>❒ Azithromycin 500 mg IV/PO daily for 3 days | ❒ Levofloxacin 750 mg PO q24h (B-lactam allergy) for 5 days |
| **Inpatients, non-ICU (Elderly (>65 yrs), medical comorbidities or recent antibiotics use in the last 3 months use)** | ❒ Augmentin 1.2 GM IV q 8h PLUS<br>❒ Azithromycin 500 mg IV/PO daily for 5 days | ❒ Levofloxacin 750 mg PO q24h (B-lactam allergy) for 5 days PLUS<br>❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg 8-12 hr for 5 days |
| **Inpatients, ICU (admission) With no risk for MRSA and Pseudomonas** | ❒ Augmentin 1.2 GM IV Q 8 hr PLUS<br>❒ Azithromycin 500 mg IV/PO daily for 7 days | Levofloxacin 750 mg IV q24h for 7 days |
| **Inpatients, ICU (admission) With risk of MRSA: Previous MRSA colonization, necrotizing pneumonia, gross hemoptysis, rapidly increasing pleural fluid empyema, pustules or erythematous rash or recent influenza like illness)** | ❒ Augmentin 1.2 GM IV Q 8 hr PLUS Azithromycin 500 mg IV/PO daily for 7 days<br>PLUS<br>❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg 8-12 hr<br>***Vancomycin, target trough serum concentration of 15-20 µg/mL***<br>**If sputum culture (good quality)/nasal PCR grow no MRSA then de-escalate to Augmentin Plus Azithromycin.** | Levofloxacin 750 mg IV q24h for 7 days PLUS<br><br>**If sputum culture (good quality)/nasal PCR grew no MRSA then de-escalate to Augmentin Plus Azithromycin.** |

| | | |
|---|---|---|
| **Inpatients, ICU (admission) With risk of MRSA: Previous MRSA colonization, necrotizing pneumonia, gross hemoptysis, rapidly increasing pleural fluid empyema, pustules or erythematous rash or recent influenza like illness)** | ❒ Augmentin 1.2 GM IV Q 8 hr PLUS Azithromycin 500 mg IV/PO daily for 7 days<br>PLUS<br>❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg 8-12 hr<br><br>***Vancomycin, target trough serum concentration of 15-20 µg/mL***<br>**If sputum culture (good quality)/nasal PCR grow no MRSA then de-escalate to Augmentin Plus Azithromycin.** | Levofloxacin 750 mg IV q24h for 7 days PLUS<br><br>**If sputum culture (good quality)/nasal PCR grew no MRSA then de-escalate to Augmentin Plus Azithromycin.** |
| **Inpatients, ICU with risk factors for Pseudomonas: Severe Structural lung disease (e.g. bronchiectasis), recent hospital admission / antibiotics use in the previous 3 months or steroid use (>10 mg of prednisolone daily in the last 2 weeks, immunocompromised)** | ❒ Piperacillin/tazobactam 4.5g IV q6h **PLUS**<br>❒ Azithromycin 500 mg IV/PO daily **PLUS**<br>❒ Amikacin IV 15 mg/kg (if amikacin drug monitoring is available)<br><br>**If sputum culture (good quality) grew no pseudomonas then de-escalate to Augmentin Plus Azithromycin.** | ❒ Piperacillin/tazobactam 4.5g IV q6h **+** Ciprofloxacin 400 mg IV q8h + Azithromycin 500mg IV q24hr<br><br>**If sputum culture (good quality) grew no pseudomonas then de-escalate to Augmentin Plus Azithromycin.** |
| **Influenza virus** | ❒ Oseltamivir (Tamiflu) 75mg q12hr for 5 days | N/A |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:

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Mandell LA, Wunderink RG, Anzueto A, *et al.* (March 2007). "Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults". *Clinical Infectious Diseases* **44** (Suppl 2): S27–72.

_____ **Hospital**
**Pharmaceutical Care Department**

_____ **Region**
**(Antibiotic Stewardship Program)**

**Physician Order Form**

(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs)

MRN. ☐☐☐☐☐☐☐

NAME: _____

AGE: ☐☐ SEX: ☐ M ☐ F

NATIONALITY: _____

WEIGHT (ACTUAL/ESTIMATED) _____KG

HEIGHT: _____CM

ALLERGY: _____

## *Peritonitis*

**Primary peritonitis: Spontaneous bacterial peritonitis (SBP)=Primary infection**

Culture: ❒ Pending ❒ (+) Culture ❒ (–) Culture ❒ Not sent

**Primary peritonitis therapy** (for renal failure patient see appendix)

| Patient's condition | First line | Alternative | Duration |
|---|---|---|---|
| For treatment | ❒ Ceftriaxone IV 2 gm q24h | ❒ Ciprofloxacin 400 mg IV q12h (β-lactam allergy) | 5-7 days |
| Prevention of SBP in patients with chronic ascites | Indications of antibiotic prophylaxis:<br>1- Patients with cirrhosis and gastrointestinal bleeding.<br>2- Patients who have had one or more episodes of SBP. | | |
| | ❒TMP-SMX-960mg tab PO 5 days/week | ❒ Ciprofloxacin 750 mg PO once/week | |
| Resistant *E. coli*, Klebsiella species (e.g., ESBL): | ❒ Ertapenem 1g IV q 24 hrs | ❒ Imipenem 500mg IV q6h | 5-7 days |

**Secondary Peritonitis Therapy (bowel perforation, ruptured appendix, ruptured diverticula)**
**Source control is essential**

| Patient's condition | First line | Alternative | Duration |
|---|---|---|---|
| Mild/Moderate Peritonitis; inpatient; Hemodynemically stable | ❒ Cefuroxime 750 mg IV q8h PLUS<br>❒ Metronidazole 500 mg IV q8h | ❒ Ciprofloxacin 400 mg IV q8h (β-lactam allergy) **PLUS**<br>❒ Metronidazole 500 mg IV q8h | 7 days +good |
| Severe Disease: Patient is admitted to ICU | Piperacillin- Tazobactam IV 4.5 gm q6h | Imipenem 500 mg IV q6 hrs | 10 days with good source controlled |

**Peritonitis, Dialysis (CAPD) Associated:**

Culture: ❒ Pending ❒ ( + ) Culture ❒ (–) Culture ❒ Not sent

**Peritonitis, Dialysis-associated; Therapy:** (for renal failure patient see appendix)

| Patient's condition | First line | Alternative | Duration |
|---|---|---|---|
| Mild – moderate | ❒ Cefazolin IP 15-20 mg/kg daily **PLUS**<br>❒ Gentamycin 2mg/kg loading then 0.6mg/kg in one bag q24h | ❒ Aztreonam 2g IP daily **PLUS**<br>❒ Vancomycin 15-30 mg/kg IP every 5-7 days for penicillin allergy) | *S. aureus:* **21 days**<br>Enerococcci, G (-) NOT Pseudomonas.<br>Pseudomonas: **21-28 days**<br>Streptococci and Coagulase negative Staph: **14 days** |
| Severe | ❒ Vancomycin IV 20mg/kg LD then 20mg/kg every 4-7 days **PLUS**<br>❒ Piperacillin-tazobactam IV 2.25 g q12h (14 days) | ❒ Vancomycin IV 15mg/kg q8hr **PLUS**<br>❒ Aztreonam 1-2 g LD then 250-500mg q6-12h | |

Physician Name: _____ pager/ mobile: _____

Physician signature: _____

Nurse name: _____ Nurse signature: _____

Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:

1. Solomkin JS,et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: Clin Infect Dis. 2010 Jun 15;50(12):1695 -Antimicrobial Therapy, WEBEDITION/Sanfordguide 2014

2. Runyon BA,et al. Management of adult patients with ascites due to cirrhosis: an update. Hepatology. 2009 Jun;49(6):2087-10

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_____ **Region**
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**Physician Order Form**

(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs)

MRN. ☐☐☐☐☐☐☐☐
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NATIONALITY: _____
WEIGHT (ACTUAL/ESTIMATED) _____KG
HEIGHT: _____CM
ALLERGY: _____

## *Brucellosis*

Culture: ❒ Pending ❒ (+) Culture ❒ (–) Culture ❒ Not sent

Therapy of brucellosis (dosing of renal failure, see appendix)

| Site of Infection | First line | Alternative/ comments |
|---|---|---|
| Non-localizing disease | ❒ Doxycycline 100 mg PO q12hr x 6 weeks **PLUS** ❒ Streptomycin 1 gm IM q24hr x 14-21 days | ❒Doxycycline 100 mg PO q12hr x 6 weeks PLUS ❒ TMP-SMX 960 mg PO q12hr x 6 weeks |
| Spondylitis/ sacroileitis/arthritis<br><br>Inpatient | ❒ Doxycycline 100 mg PO q12hr for 6-8 weeks **PLUS** ❒ Gentamycin IV 3mg/kg q24hr (for 2-3 weeks) ***Gentamycin Target trough <1 µg/mL*** | ❒ Doxycycline 100 mg PO q12hr PLUS ❒ TMP-SMX 5 mg/kg of TMP component IV q12hr both for 6-8 weeks |
| Outpatient | ❒Doxycycline 100 mg PO q12hr for 6-8 weeks **PLUS** ❒ Streptomycin 1 gm IM q24h (for 2-3 weeks) | ❒ Doxycycline 100 mg PO q12hr PLUS ❒ TMP-SMX 960 mg PO q12hr both for 6-8 weeks |
| Brucella during Pregnancy | ❒ TMP-SMX 960 mg PO q12hr **PLUS** ❒ Rifampicin 900mg q24hrfor both x 6 weeks TMP-SMX may cause kernicterus if given in last week of pregnancy | **<u>If ≥ 38 weeks</u>** ❒ Rifampicin 900mg PO q24hr x 12 weeks <u>After delivery, consider changing</u> to ❒ Doxycycline 100 mg PO q12hrx6 weeks PLUS ❒ Streptomycin 1 gm IM q24h x2 weeks |
| Neurobrucellosis | ❒ Doxycycline 100 mg IV/PO q12hr x 12-24 weeks **PLUS** ❒ Rifampicin 900 mg PO/IV q 24hrs x12-24 weeks **PLUS** ❒ TMP-SMX 960 mg PO q12h x 12-24 weeks **PLUS** ❒ Ceftriaxone 2 gm IV q12h x 4 WK | Continue until CSF is sterile |
| Endocarditis | ❒ Doxycycline 100 mg IV/PO q12hr x12-24 months **PLUS** ❒ Gentamycin 5 mg/kg IV q 24h x 2-3 weeks **PLUS** ❒ TMP-SMX 5 mg/kg IV q12h x 12-24 weeks **PLUS** ❒ Rifampicin 600mg IV/PO q 12 hrs for 12-24 weeks ***Gentamycin trough level < 1 µg/mL*** | Surgical intervention combined with Antimicrobial therapy is superior to medical treatment alone. |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:
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Brucellosis in humans and animals, WHO.2006; Antimicrobial Therapy, WEBEDITION/Sanford guide 2014

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## *TUBERCULOSIS*

**Treatment of Latent TB recommended for:**

| | | |
|---|---|---|
| patients at increased risk for developing active disease, such as those co-infected with HIV or receiving immunosuppressive therapy, children <5 years old, those with diabetes or chronic renal failure on hemodialysis | Close contacts of patients with recent pulmonary TB | Those who have converted from (-) to a (+) tuberculin skin test PPD or interferon-gamma release assay (IGRA) within the previous 2 years. |

**Therapy for Latent TB** (doses for renal failure patients see appendix)

Isoniazid 5 mg/kg/day (max 300 mg/day) or 15 mg/kg 2x/wk (max 900 mg/dose) x 9 months
Isoniazid 15 mg/kg (max 900 mg/dose) + rifapentine 300-900 mg weekly x 12 weeks
Rifampin 10 mg/kg/day (max 600 mg/day) or 10 mg/kg 2x/wk (max 600 mg/dose) x 4 months

**Active Pulmonary TB:**

| | | | |
|---|---|---|---|
| Smear | (+) culture | PCR | Histopathology |

**Therapy for Active Pulmonary TB** (for renal failure patient see appendix)
**1) First-line Treatment of Active TB, Initial phase**

| Condition | Drugs | Adult Dosage | | Alternative | Duration |
|---|---|---|---|---|---|
| | | Daily | Intermittent | | |
| Empiric initial treatment should include 4 drugs: | Isoniazid | 5 mg/kg | 15 mg/kg 1-3x/wk | | 2 months |
| | Rifampin (RIF) | 10 mg/kg | 10 mg/kg 2-3x/wk | Rifabutin (RPT 5 mg/kg | |
| | pyrazinamide | 40-55 kg: 1000 mg<br>56-75 kg: 1500 mg<br>76-90 kg: 2000 mg | 40-55 kg: 2000 mg<br>56-75 kg: 3000 mg<br>76-90 kg: 4000 mg<br>2x/wk | | |
| | Ethambutol | 40-55 kg: 800 mg<br>56-75 kg: 1200 mg<br>76-90 kg: 1600 mg | 40-55 kg: 2000 mg<br>56-75 kg: 2800 mg<br>76-90 kg: 4000 mg | | |
| When M. TB is susceptible to isoniazid, rifampin and pyrazinamide | Isoniazid(INH) | 5 mg/kg | 15 mg/kg 1-3x/wk | | |
| | Rifampin | 10 mg/kg | 10 mg/kg 2-3x/wk | Rifabutin 5 mg/kg | |
| | Pyrazinamide | 40-55 kg: 800 mg<br>56-75 kg: 1200 mg<br>76-90 kg: 1600 mg | 40-55 kg: 2000 mg<br>56-75 kg: 2800 mg<br>76-90 kg: 4000 mg | | |
| Patients who cannot take pyrazinamide, such as those with severe liver disease or gout | Isoniazid<br>Rifampin<br>ethambutol | The same dose as above | The same dose as above | Rifabutin 5 mg/kg | |

*Treatment of Pulmonary TB, cont'd*

**2) Duration of Continuation Therapy (For treatment of drug-susceptible disease after two months of initial therapy)**:

| Cavity on Chest (x-ray) | Sputum Culture (Taken at 2 Months) | Drugs | Duration (months) |
|---|---|---|---|
| **No** | Negative | INH PLUS RIF | 4 |
| **No** | Positive | INH PLUS RIF | 7 |
| **Yes** | Negative | INH PLUS RIF | 4 |
| **Yes** | Positive | INH PLUS RIF | 7 |
| **Patients who could not take pyrazinamide as part of the initial regimen** | | INH PLUS RIF | 7 |

**Some Second-Line Drugs for Active Tuberculosis**

| | |
|---|---|
| Streptomycin | 15 mg/kg IM or IV (max 1 g) |
| Capreomycin (Capastat) | 15 mg/kg IM or IV (max 1 g) |
| Kanamycin (Kantrex, | 15 mg/kg IM or IV (max 1 g) |
| Amikacin | 15 mg/kg IM or IV (max 1 g) |
| Cycloserine (Seromycin) | 10-15 mg/kg PO |
| Ethionamide (Trecator) | 15-20 mg/kg in 1 or 2 divided doses PO (max 500 mg q12hr) |
| Levofloxacin | 500-1000 mg PO/ IV |
| Moxifloxacin | 400 mg PO or IV |
| Para-aminosalicylic acid | 8-12 g in 2-3 doses PO |

| | |
|---|---|
| **Resistance to Rifamycins**<br>Check with the who reference | -At least 12 months of treatment with isoniazid, ethambutol and a fluoroquinolone (levofloxacin or moxifloxacin can be used).<br>-Pyrazinamide, with or without an injectable drug, should also be used during the initial 2 months of therapy. |
| **Multidrug Resistance** Isolates with resistance to at least isoniazid and rifampin | Refer to the specialized ID physician or expert Pulmonologist |
| **Extensively drug-resistant TB** (XDRTB)<br>Isolates with resistance not only to isoniazid and rifampin, but also to any fluoroquinolone and at least one of three injectable second-line drugs (i.e., amikacin, kanamycin or capreomycin) | Refer to the specialized infectious diseases or expert Pulmonologist |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:
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**Drugs for Tuberculosis.** Treatment Guidelines from The Medical Letter. April 2012;10 (116) 29-35
Abbreviations:
Rifampicin (RIF), Rifabutin (RPT), Isoniazid (INH)

| | |
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***Bacterial Meningitis and Encephalitis***

- **Early recognition and prompt initiation of antibiotics are crucial.**
- **Blood cultures and LP should be obtained emergently before starting antimicrobial therapy**
- **Antimicrobial therapy, along with adjunctive dexamethasone when indicated, should be initiated as quickly as possible after the performance of the lumbar puncture (LP) or**, if a computed tomography (CT) scan of the head is to be performed before LP, **as quickly as possible after blood cultures are obtained**

CSF Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

Therapy for Bacterial Meningitis (renal failure patient, see appendix)

Dexamethasone 0.15 mg/kg IV q6h X2-4 days (first dose before or with 1st dose of antibiotics

| Patient group | First line | Alternative/ comments |
|---|---|---|
| ≤ 50 years | ❒ Vancomycin IV loading dose of 25 mg/kg then 15 mg/kg/dose IV q8hr PLUS<br>❒ Cefotaxime IV 2g q4–6h<br>**Vancomycin calculated dose**<br>……<br>Vancomycin target trough serum concentration of 15-20 µg/mL | ❒ Vancomycin IV loading dose of 25 mg/kg Then, 15 mg/kg/dose IV q8hr PLUS<br>❒ Ceftriaxone 2g IV q 12 h<br>**Vancomycin calculated dose**<br>……..<br>Vancomycin target trough serum concentration of 15-20 µg/mL |
| ≥ 50 years | ☐ Vancomycin IV 15 mg/kg q8h PLUS<br>☐ Ampicillin IV 2g q4h PLUS<br>Cefotaxime IV 2g q4–6h<br>**Vancomycin calculated dose**<br>……<br>☐ Vancomycin target trough serum concentration of 15-20 µg/mL | ☐ Vancomycin IV 15 mg/kg q8h PLUS<br>☐ Ampicillin IV 2g q4h PLUS<br>❒ Ceftriaxone IV 2g q12h<br>**Vancomycin calculated dose**<br>……<br>Vancomycin target trough serum concentration of 15-20 µg/mL |
| Head trauma: Basilar skull fracture | ❒ Vancomycin IV 15-20 mg/kg q8h PLUS<br>❒ Ceftriaxone IV 2g q12h.<br>**Vancomycin calculated dose**<br>……<br>Vancomycin target trough serum concentration of 15-20 µg/mL | ❒ Meropenem 1 gm IV q8h PLUS<br>❒ Vancomycin IV 15-20 mg/kg q8h<br>**Vancomycin calculated dose**<br>……<br>Vancomycin target trough serum concentration of 15-20 µg/mL |
| Penetrating injury or post-neurosurgery meningitis | ❒ Meropenem 1 gm IV q8h PLUS<br>❒ Vancomycin IV 15 mg/kg q8h<br>**Vancomycin calculated dose**<br>……<br>❒ Vancomycin target trough serum concentration of 15-20 µg/mL | ❒ Cefepime 2 gm IV q8h PLUS<br>❒ Vancomycin IV 15 mg/kg q8h.<br>**Vancomycin calculated dose**<br>……<br>❒ Vancomycin target trough serum concentration of 15-20 µg/mL |

| | | |
|---|---|---|
| Shunt or external ventricular drain (EVD) related infection<br><br>(EVD should be changed) | ❒ Meropenem 1 gm IV q8h PLUS<br>❒ Vancomycin IV 15 mg/kg q8h<br><br>**Vancomycin calculated dose**<br>……<br><br>❒ Vancomycin target trough serum concentration of 15-20 µg/mL | ❒ Cefepime 2 gm IV q8h PLUS<br>❒ Vancomycin IV 15 mg/kg q8h.<br>**Vancomycin calculated dose**<br>……<br><br>❒ Vancomycin target trough serum concentration of 15-20 µg/mL<br><br>If sever beta lactam allergy:<br>❒ Ciprofloxacin 400 mg IV q8h PLUS<br>❒ Vancomycin IV 15 mg/kg q8h<br>**Vancomycin calculated dose**<br>……<br><br>❒ Vancomycin target trough serum concentration of 15-20 µg/mL |
| Meningoencephalitis | ❒ Vancomycin IV 15 mg/kg q8h PLUS<br>❒ Ampicillin IV 2g q4h PLUS<br>❒ Meropenem 2 g q8h PLUS<br>❒ Acyclovir 10 mg/kg/dose IV q8h for 10 days<br>**Vancomycin calculated dose**<br>……<br><br>❒ Vancomycin target trough serum concentration of 15-20 µg/mL | ❒ Vancomycin IV 15-20 mg/kg q8h PLUS<br>❒ Ampicillin IV 2g q4h PLUS<br>❒ Cefepime IV 2g q 8h PLUS<br>❒ Acyclovir 10 mg/kg/dose IV q8hr for10 ays<br>**Vancomycin calculated dose**<br>……<br><br>❒ Vancomycin target trough serum concentration of 15-20 µg/mL |

| Specific Organism | | Antibiotic Therapy | | Duration |
|---|---|---|---|---|
| **S. pneumoniae** | Penicillin MIC<br><br>< 0.1 mg/mL | ❒<br><br>❒ | Penicillin G 4 million Unit IV q4hr OR<br>Ampicillin IV 2 g q4hr | 10-14 days |
| | Penicillin MIC<br>0.1–1.0 mg/mL | ❒ | Ceftriaxone IV 2 gm q12hr | |
| | Penicillin MIC<br>≥ 1.0 mg/mL | ❒<br>❒ | Vancomycin IV loading dose of 25mg/kg then 1g q8hr PLUS Ceftriaxone IV 2 g q12hr<br>Vancomycin, target trough serum concentration of 15-20 µg/mL | |
| ***Neisseria meningitids*** | | ❒ | Ceftriaxone IV 2 g q12hr | 7 days |
| ***Listeria monocytogenes*** | | ❒ ❒<br>❒<br><br>❒ | Ampicillin IV 2 gm q4h ±<br>Gentamicin 2 mg/kg loading dose then 1.7 mg/kg q8h OR<br>Trimethoprim-sulfamethoxazole IV 5 mg/kg [based on the trimethoprim component] q6-12 hr<br>Calculated dose: ……. OR<br>Meropenem IV 2 g q 8hr | 21 days |
| ***Haemophilus influenzae*** | | ❒ | Ceftriaxone IV 2 gm q12h | 7 days |
| ***Staphylococcus aureus*** | ***Methicillin susceptible (MSSA)*** | ❒<br><br>❒ | Flucloxacillin IV 2g oral q4-6hr OR<br><br>Cloxacillin IV 2 g oral q4-6hr | 14days |
| | ***Methicillin resistance*** | ❒ | Vancomycin IV loading dose of 25 mg/kg then 1 g q8hr ± Rifampin PO 600 mg q24hr OR | |

| | | | | |
|---|---|---|---|---|
| | ***(MRSA)*** | ❒<br>❒ | Linezolid IV 600 mg q12h<br>Vancomycin, target trough serum concentration of 15-20 µg/mL | |
| ***Staphylococcus epidermidis*** | | ❒<br>❒ | Vancomycin IV loading dose of 25mg/kg then 1g q8hr<br>Vancomycin, target trough serum concentration of 15-20 µg/mL OR<br>linezolid IV 600 mg q12hr | 14days |
| ***Enterococcus species*** | Ampicillin susceptible | ❒<br>❒ | Ampicillin IV 2 g q4h ±<br>Gentamicin IV 1 mg/kg q8h<br>Gentamicin dose: ……(trough levels of <1 mcg/mL) | 14-21 days |
| | Ampicillin resistant | ❒<br>❒ | Vancomycin IV loading dose of 25 mg/kg then 1g q8hr ±<br>Gentamicin IV 1 mg/kg q8h<br>Gentamicin Calculated dose: …….. (trough levels of <1 mcg/mL) | |
| | Ampicillin and vancomycin resistant | ❒ | Linezolid IV 600 mg q 12hr | 28 days |
| **Gram negative** | | ❒<br>❒ | Meropenem 2 gm IV q8h OR<br>Ciprofloxacin 400 mg IV q8h | |
| **Meningitis prophylaxis**<br>***N. meningitidis*** | | ❒<br>❒<br>❒ | Only indicated for "close contact" who have had prolonged (>8 hours) contact while in close proximity (<1 meter) to the patient or who have been directly exposed to the patient's oral secretions during the 7 days before the onset of the patient's symptoms and less than24 hours of initiation of appropriate antibiotic therapy.<br>Ciprofloxacin 500 mg PO one dose **OR**<br>Ceftriaxone 125-250 mg IM one dose **OR**<br>Rifampicin 600mg PO q12hr for 4 doses | |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note

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Allan R. Tunkel,1 Barry J. Hartman,Practice Guidelines for the Management of Bacterial Meningitis" Infectious Diseases ; 2004 ; 39 : 1267 -Sanford guide Antimicrobial Therapy, web edition, Inc. 2014

_____ **Hospital**
**Pharmaceutical Care Department**

_____ **Region**
**(Antibiotic Stewardship Program)**

**Physician Order Form**

(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs)

MRN. ☐☐☐☐☐☐☐☐
NAME:_____
AGE: ☐☐ SEX: ☐ M ☐ F
NATIONALITY:_____
WEIGHT (ACTUAL/ESTIMATED)_____KG
HEIGHT: _____CM
ALLERGY: _____

## *Brain Abscess*

Culture: ❒ Pending ❒ ( + ) Culture ❒ ( - ) Culture ❒ Not sent

**Empiric Therapy for brain abscesses (for renal failure patient see appendix)**

| **Empiric (Origin of abscess)** | | **Therapy (dosing interval in hours)** | **Duration** |
|---|---|---|---|
| Oral source;<br>Otogenic; or sinus source | | ❒ Ceftriaxone IV 2 g q12hr PLUS<br>❒ Metronidazole 500 mg IV q8hr OR<br>❒ Penicillin G 3-4 million units IV q4h PLUS<br>❒ Metronidazole 500 mg IV q8hr | Duration of treatment is unclear. Treat until response by neuroimaging (CT/MRI). |
| Hematogenous spread<br>Suspect<br><br>*Staph. aureus* | *MSSA* | ❒ Flucloxacillin IV 2g oral q4-6hr OR<br><br>❒ Cloxacillin IV 2 g oral q4-6hr | |
| | *MRSA* | ❒ Vancomycin IV loading dose of 25 mg/kg then 1 g q8hr ±<br>❒ Metronidazole IV 500 mg q8hr<br>(Vancomycin target trough serum concentration of 15-20 µg/mL) | |
| Postoperative neurosurgical patients | | ❒ Vancomycin IV loading dose of 25 mg/kg then 1g q8hr PLUS<br>❒ Meropenem IV2 g q8hr OR<br>❒ Vancomycin IV loading dose of 25 mg/kg 1g q8hr PLUS<br>❒ Ceftazidime IV 2 g q8hr<br>(vancomycin target trough serum concentration of 15-20 µg/mL) | |
| Penetrating trauma<br>OR unknowing source | | ❒ Vancomycin IV loading dose of 25 mg/kg then 1g q8hr PLUS<br>❒ Ceftriaxone IV 2 g q12hr<br>(Vancomycin target trough serum concentration of 15-20 µg/mL)<br>If the paranasal sinuses are involved, add<br>❒ Metronidazole 500 mg IV q8hr | |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist note:
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|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***GENITOURINARY TRACT INFECTION***

**Bacterial urinary tract infections (UTI)**

**Management of patients WITHOUT a urinary catheter**

| Infection Type | First Line Therapy | Alternative Therapy |
|---|---|---|
| **Asymptomatic Bacteriuria (Positive urine culture ≥100,000 CFU/with no signs or symptoms)** | **No treatment unless patient is:**<br>• Pregnant<br>• About to undergo a urologic procedure<br>• Neutropenia<br>**Notes:**<br>▪ **Obtain routine cultures in asymptomatic patients is not recommended**<br>**Antibiotics do not decrease asymptomatic bacteriuria or prevent subsequent development of UTIs** | |
| **Acute cystitis** | **Uncomplicated:** (female, no urologic abnormalities, no stones, no catheter)<br>▪ If local prevalence of resistance to TMP/SMX is <20%<br>☐ TMP/SMX double strength 1 tab orally twice daily for 3 days<br>▪ If sulfa allergy or > 20% *E.coli* resistance to TMP/SMX<br>☐☐☐Nitrofurantoin (**Macrobid®**) 100 mg orally every 12 hours for 5 days (Not in patients with CrCl <50 ml/min)<br>**Complicated:** (male gender, possible stones, urologic abnormalities, pregnancy)<br>☐ Same as above except duration for 7-10 days | ☐ **Amoxicillin-clavulanate** 875/125 mg oral tab every 12 hours for 5 days<br>**OR**<br>☐ **Cefuroxime 500 mg oral tab every 12** hours for 5 days |
| **Acute pyelonephritis** | **Out patients:**<br>☐ Ceftriaxone 1 g IV every 24 hours for 7 days<br>☐ Ertapenem 1 g IV every 24 hours for 7 days (if history of ESBL)<br>**Hospitalized >48 hours**<br>☐ Piperacillin /Tazobactam IV 4.5 g every 6 hours for 14 days<br>**OR**<br>☐ Ceftazidim 2 gm IV every 8 hours | **If penicillin Allergy**<br>☐ **Aztreonam 1 gm IV every 8 hours**<br>**OR**<br>☐ Gentamicin 5mg/kg IV as extended interval dosing<br>**Out patients:**<br>☐ Amoxicillin-clavulanate 875/125 mg oral tab every 12 hours for 14 days **OR**<br>☐ TMP/SMX double strength 1 tab orally twice daily for 14 days (If local prevalence of resistance to TMP/SMX is <20%) **OR**<br>☐ Ciprofloxacin 500 mg oral tab every 12 hours **for 7 days (if susceptible) OR**<br>**Hospitalized >48 hours**<br>☐ Imipenem 500 mg IV every 6 hours for 14 days |

| | | |
|---|---|---|
| **Urosepsis** (hypotension, tachypnea (≥ 20/min), tachycardia (≥ 90/min), altered mental state) | ☐ Imipenem 500 mg IV every 6 hours for 14 days | **<u>If penicillin Allergy</u>**<br>☐ **Aztreonam 1 gm IV every 8 hours +** Gentamicin 5mg/kg as extended interval dosing |
| **Management of patients WITH a urinary catheter** | | |
| **Infection Type** | **First Line Therapy** | **Alternative Therapy** |
| **Asymptomatic Bacteriuria** (Positive urine culture ≥100,000 CFU/Ml with no signs or symptoms) | ☐ **Remove the catheter when possible**<br>☐ **No treatment needed** | |
| **Catheter-associated UTI:**<br><br>(Fever with no other source is the most common, patients may also have suprapubic or flank pain<br><br>**AND**<br><br>Pyuria (>10 WBC/hpf) **AND** Positive urine culture ≥ 1000 CFU/mL | ☐ **Remove the catheter when possible for all**<br><br>**<u>For Cystitis</u>**<br>☐ Cefepime 2 gm IV every 8 hours<br><br>**<u>For Pyelonephritis</u>**<br>☐ Piperacillin / Tazobactam IV 4.5 g every 6 hours for 14 days<br><br>**<u>Duration</u>**<br>☐ 5-7 days for cystitis<br>☐ 10-14 days for pyeleonephritis<br>☐ 14-21 days for complicated infection | ☐ **<u>For Cystitis</u>**<br><br>☐ Ertapenem 1 g IV every 24 hours for 7 days<br><br>**<u>For Pyelonephritis</u>**<br><br>☐ Imipenem 500 mg IV every 6 hours for 10-14 days<br>☐ |
| **Management of patients Candiduria (Urinary catheter removal will resolve the candiduria in 40% of cases)** | | |
| **Type of infection** | **First Line Therapy** | **Alternative Therapy** |
| **Asymptomatic cystitis** | ☐ **Therapy not usually indicated**<br>**<u>Treatment if patient is:</u>**<br><br>❖ Urinary obstruction or abnormal GU tract<br>❖ About to undergo a urologic procedure<br>❖ Neutropenia<br>☐ Fluconazole 400 mg PO once daily for 7 days | ☐ Ampho B IV 0.3 mg/kg daily for 7 days |
| **Symptomatic cystitis** | ☐ Fluconazole 400 mg PO once daily for 7 days | ☐ Amphotericin-B IV 0.5 mg/kg daily for 7 days |
| **Pyelonephritis** | ☐ Fluconazole 400 mg PO once daily for 14 days | ☐ Ampho B IV 0.7 mg/kg daily for 14 days |
| Candida vaginitis | ☐ Fluconazole 150 mg orally as single dose | ☐ Miconazole 2% cream 5 g intravaginally once daily for 7 days |

| | |
|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***GENITOURINARY TRACT INFECTION***

**Antibiotic order (Pelvic Inflammatory Disease)**

Diagnosis: ……..

Culture: □ Pending □ ( + ) Culture □ ( - ) Culture □ Not sent

Therapy for PID (for renal failure patient, see appendix

| Empiric therapy | Therapy (dosing interval ) | |
|---|---|---|
| Outpatient: | 1□<br>2□ | Ceftriaxone 250 mg IM x 1 dose followed by Azithromycin 1 gm PO weekly x 2 weeks<br>Cefoxitin 2 gm IM with Probenecid PO 1 gm both as single dose + Doxycycline 100 mg PO q12hr with Metronidazole 500 mg q12hr both x 14 |
| Inpatient: | 1□<br>2□ | Ceftraixone IV 2 g q24 h + Doxycycline IV/PO 100 mg q12h<br>Clindamycin 900 mg IV q8h + Gentamicin 1mg/kg IV/IM q8hr , then Doxycycline 100 mg PO q12hr x 14 days<br>Gentamicin Calculated dose: ……. Target trough <1 µg/mL |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist
Note:_____
_____
_____

# National Antimicrobial Guidelines for Hospital-Acquired Infections in Adults

| | |
|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***Central line associated Blood Stream Infection (CLABSI)***

**Management of Patient with Tunneled Line**

- **Etiologies in patients with tunneled IV Line:**
  - ***Staphylococcus aureus***
  - ***Staphylococcus epidermises***
  - ***Leuconostoc* (intrinsically resistant to vancomycin, sensitive to Ampicillin or clindamycin)**
  - **Gram negative bacilli**
  - **Candida sp.**
- **Burn or neutropenic patient, etiologies will include in addition to the above.**
  - **Pseudomonas sp.**
  - **Enterobacteriaceae**
  - ***Corynebacterium jeikeium***
- **Long term alimentation**
  - **Candida sp.**

| Infection Type | First Line Therapy | Alternative Therapy |
|---|---|---|
| **Empiric therapy** | ☐ Piperacillin-Tazobactam 4.5 gm IV q6h PLUS<br>☐ Vancomycin 1gm IV q 12h. OR<br>☐ Meropenem 1 gm IV q8h PLUS<br>☐ Vancomycin 1gm IV q 12h. (target trough 15-20/ml) | ☐ Cefepime 2 gm iv q8h PLUS<br>☐ Vancomycin 1gm IV q 12h |

| | |
|---|---|
| Patient requiring **Long term alimentation, or high risk for Candida sp. infection** | **Add to any of the above regimen**<br>☐ Caspofungin 70 mg IV on day 1, then 50 mg q24h, OR<br>☐ Anidulafungin 200 mg IV on day 1 followed by 100 mg q24h. |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist
Note:_____
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|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

## *Central line associated Blood Stream Infection (CLABSI)*

### Management of Patient with Non-Tunneled Line

- **Etiologies in patients with Non-tunneled IV Line:**
  - ***Staphylococcus aureus***
  - **Coagulase negative Staphylococcus**
  - ***Enterococcus faecalis***
  - **Non-albicans Candida sp.**
- **Oncology unit patients, etiologies will include in addition to the above.**
  - **Pseudomonas sp.**
  - **Enterobacteriaceae**
  - ***Enterococcus faecium***
  - **Long term alimentation**
  - **Candida sp.**

| Infection Type | First Line Therapy | Alternative Therapy |
|---|---|---|
| ***Staphylococcus aureus***<br>Remove catheter<br>**MRSA** | ☐ Oxacillin 2 gm IV q4h.<br>☐ Cephazolin 2 gm IV q8h.<br><br>☐ Vancomycin 1gm IV q 12h. (target trough 15-20/ml) | ☐ Piperacillin-Tazobactam 4.5 gm IV q6h<br><br>☐ Daptomycin 6 mg/kg IV q24h (Not for Lung Infection) OR<br>☐ Linezolid 400 mg IV q12h. |
| **Coagulase negative Staphylococcus** | ☐ Vancomycin 1gm IV q 12h<br>☐ (target trough 15-20/ml) | ☐ None |
| **Enterococcus sp.** | Penicillin susceptible strains<br>☐ Ampicillin 2 gm IV q4h.<br>Penicillin resistant strains<br>☐ Vancomycin 1gm IV q 12h. (target trough 15-20/ml) | ☐ Linezolid 400 mg IV q12h. OR<br><br>☐ Daptomycin 8 mg/kg IV q24h (Not for Lung Infection) |
| **Enterobacteriaceae**<br><br>Remove catheter | ☐ Piperacillin-Tazobactam 4.5 gm IV q6h OR<br>☐ Meropenem 1 gm IV q8h if suspected carbapenem resistance add Colistin or aminoglycoside | ☐ Cefepime 2 gm IV q8h. |
| Patient requiring **Long term alimentation, or high risk for Candida sp. Infection** (**Remove Catheter)** | Add to any of the above regimen<br>☐ Caspofungin 70 mg IV on day 1, then 50 mg q24h, or Anidulafungin 200 mg IV on day 1 followed by 100 mg q24h. | |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist Note:_____

| | |
|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***Hospital Acquired Pneumonia (HAP)& Ventilator Associated Pneumonia (VAP)***

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

Risk Factors for Multidrug-Resistant Pathogens:

***Risk factors for multi-drug resistance (MDR) VAP**

Prior intravenous antibiotic use within 90 days

Septic shock at time of VAP

ARDS preceding VAP

Five or more days of hospitalization prior to the occurrence of VAP

Acute renal replacement therapy prior to VAP onset

***Risk factors for MDR HAP**

Prior intravenous antibiotic use within 90 days

***Risk factors for methicillin-resistant staphylococcus aureus** (**MRSA) VAP/HAP**

Prior intravenous antibiotic use within 90 days

**Empiric Therapy for VAP/HAP** (for renal failure dose adjustment: see appendix)

| Patient Group | First Line | Alternative | Duration |
|---|---|---|---|
| **VAP (hemodynamically stable)** | ❒ Piperacillin-tazobactam 4.5 g IV q6h PLUS<br>❒ Amikacin 15 mg/kg IV q24h<br><br>**Target amikacin trough level less than 4 mcg/ mL** | ❒ Cefepime 2 g IV q8h PLUS<br><br>❒ Ciprofloxacin 400 mg IV q8h | 7 days |
| **VAP (hemodynamically unstable)** | ❒ Vancomycin 15 mg/kg IV q12 (consider a loading dose of 25mg/kg × 1 for severe illness) PLUS<br>❒ Imipenem 500 mg IV q6h PLUS<br>❒ Colistin 9 million loading dose followed by 4.5 million IV q 12 hrs<br>**Target amikacin trough level less than 8 mcg/ mL** | ❒ Vancomycin 15 mg/kg IV q12 (consider a loading dose of 25mg/kg × 1 for severe illness PLUS<br>❒ Aztreonam 2 g IV q8h PLUS<br>❒ Colistin 9 million loading dose followed by 4.5 million q 12 hrs | 7 days |
| **HAP**<br><br>Not at high risk of mortality and no factors increasing the likelihood of MRSA | ❒ Cefepime 2 g IV q8h | ❒ Levofloxacin 750 mg IV q24h (**If penicillin allergic)** | 7 days |

| | | | |
|---|---|---|---|
| Not at high risk of mortality but with factors increasing the likelihood of MRSA | ❒ Piperacillin-tazobactam 4.5 g IV q6h PLUS<br><br>❒ Vancomycin loading dose of 25 mg/kg then 15 mg/kg IV q8- 12h<br><br>**goal to target vancomycin tough level of 15–20 mcg/ml**<br><br>Vancomycin calculated dose:…….. | ❒ Cefepime 2 g IV q8h PLUS<br><br>❒ Vancomycin loading dose of 25 mg/kg then 15 mg/kg IV q8–12h<br><br>**goal to target vancomycin tough level of 15–20 mcg/ml**<br><br>Vancomycin calculated dose:…….. | 7-10 days |
| Sepsis/septic shock, (Receipt of intravenous antibiotics during the last 90 days) | ❒ Imipenem 500 mg IV q6h PLUS<br><br>❒ Vancomycin loading dose of 25mg/kg then 15 mg/kg IV q8–12h with goal to target 15–20 mcg/ml<br><br>PLUS<br><br>❒ Amikacin 15 mg/kg IV q24h<br><br>**Target amikacin trough less than 8**<br><br>Vancomycin calculated dose:……<br><br>Vancomycin trough level: ……..<br><br>Gentamicin calculated<br><br>dose:……<br><br>Gentamicin trough level ……<1 mcg/ml | ❒ Imipenem 500 mg IV q6h<br><br>PLUS<br><br>❒ Linezolid 600 mg IV q12h PLUS<br><br>❒Gentamicin 5–7 mg/kg IV daily<br><br>Gentamicin calculate dose: ……<br><br>**Gentamicin trough level <1mcg/ml** | 10-14 days |

**De-escalate the antibiotics once the culture result is available or clinical condition improves**

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist
Note:_____
_____
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|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***Hospital acquired complicated Intra-Abdominal Infection (cIAI)***

Culture: ❒ Pending ❒ (+) Culture ❒ (-) Culture ❒ Not sent

(for renal dose adjustment dose see appendix)

**Source control is mandatory**

| Patient Group | First line | Alternative | Duration |
|---|---|---|---|
| Empiric therapy | ❒ Tigecyline 100mg IV infusion then 50mg IV infusion q12hr PLUS<br>❒ Ciprofloxacin 400 mg IV q12h | ❒ Imipenem 500 mg IV q6h PLUS<br>❒ Gentamicin IV 3-5mg/kg q24h<br>Gentamicin calculated dose:<br>……<br>Gentamicin trough level<br>……..<1 mcg/ml | 4-7 days |

**De-escalate the antibiotics once the culture result is available or patient condition improves**

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist
Note:_____
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|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***Management of Patients with Sepsis***

- **Suspected or documented infection.**
- **An acute increase of >= 2 SOFA (organ failure, oxygenation, platelet count. Bilirubin, blood pressure, renal function and mental status.**
- **A "quick" SOFA score, at least 2 of:**
  - **Respiratory rate of >= 22/min**
  - **Altered mental status**
  - **Systolic blood pressure <= 100 mmHg.**

| Infection Type | First Line Therapy | Alternative Therapy |
|---|---|---|
| **Source is unclear** | ☐ Ertapenem 1 g IV every 24 hours (if history of ESBL) + Vancomycin 1gm IV q 12h.<br>☐ Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h.<br>☐ Imipenem 0.5 gm IV q6h + Vancomycin 1gm IV q 12h. | If low prevalence of ESBL or carbapenemase aerobic gram-negative bacilli:<br>☐ Piperacillin-Tazobactam4.5 gm IV q6h + Vancomycin 1gm IV q 12h.<br>If high prevalence of ESBL or carbapenemase aerobic gram-negative bacilli:<br>☐ Colistin IV +Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h. |
| Suspect biliary source | ☐ Piperacillin-Tazobactam4.5 gm IV q6h | |
| Suspect community acquired pneumonia source | ☐ Piperacillin-Tazobactam4.5 gm IV q6h + Vancomycin 1gm IV q 12h. | |
| Suspect illicit IV drug use source | ☐ Meropenem 1 gm IV q8h + Vancomycin 1gm IV q 12h. | |
| Suspect petechial rash source | ☐ Ceftriaxone 2gm IV q12h. | |

***Follow colistin protocol according to renal function***

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist
Note:_____
_____
_____

# Surgical Prophylaxis Guidelines

| | |
|---|---|
| **_____ Hospital**<br>**Pharmaceutical Care Department**<br><br>**_____ Region**<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |

***Surgical Antibiotics Prophylaxis background***

**The goal of antimicrobial prophylaxis is to prevent surgical site infection (SSI) by reducing the burden of microorganisms at the surgical site during the operative procedure, and it's an essential element of the surgical site infection prevention bundle.**

**- Pre-operative systematic antibiotics should be <u>infused and completed</u> 60 minutes prior to first incision to (except vancomycin and fluoroquinolones should be infused 120 minutes prior to first incision to prevent RED MAN Syndrome).**

**- Patients undergoing Cardiothoracic and spinal surgery shold be screened for MRSA nasal carriage preoptively, if positive to use nasal mupirocin oinment (2%) at the evening before, day of surgery and bid x 5 days post-op, with <u>(2 or 4%)</u> chlorhexidine bodywash the night before the surgery and dialy after for 5 days.**

**- Postoperative duration of antimicrobial prophylaxis should be limited to less than 24 hours from surgery end time, regardless of the presence of indwelling catheters, drains or prosthesis .**

**- The use of antimicrobial agents for dirty procedure or established infection is classified as treatment of presumed infection, not prophylaxis. It is excluded from this guideline.**

**<u>CDC Classification of Surgical site Infections (SSIs):</u>**

**1- Clean:** An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.

**2-Clean-Contaminated:** Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

**3-Contaminated:** Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, no purulent inflammation is encountered including necrotic tissue without evidence of purulent drainage (e.g., dry gangrene) are included in this category

**<u>Surgical Site Prevention Bundle:</u>**

1-The appropriate prophylactic antibiotic was administered 60 minutes before the operation (blade to skin) and discontented after the surgery. Re-dosing of antibiotics may be required during prolonged surgery (more than two half-lives of the antibiotic used) or procedures in which there is significant blood loss (more than 1.5 L) to maintain therapeutic levels preoperatively.

2- 2% chlorhexidine gluconate in 70% isopropyl alcohol solution was used for skin preparation (povidone-iodine was used if patient sensitive or for head and neck surgeries)

3- The patient's temperature was maintained above 36°C in the perioperative period (excludes cardiac surgery)

4- The known diabetic patient's glucose level was kept <11mmol/l throughout the operation

| _____ Hospital<br>**Pharmaceutical Care Department**<br><br>_____ Region<br>**(Antibiotic Stewardship Program)**<br><br>**Physician Order Form**<br>(Please fill all applicable information and stick it on patient profile, and forward the copy to the Pharmacy Department within 24 hrs) | MRN. ☐☐☐☐☐☐☐<br>NAME:_____<br>AGE: ☐☐ SEX: ☐ M ☐ F<br>NATIONALITY:_____<br>WEIGHT (ACTUAL/ESTIMATED)_____KG<br>HEIGHT: _____CM<br>ALLERGY: _____ |
|---|---|

| ***Surgical Antibiotics Prophylaxis Guideline*** | | |
|---|---|---|
| **Type of Surgery** | **Preferred regimen** | **Alternative** |
| **Colorectal**<br>**Appendoctomy (uncomplicated)**<br><br>**Hernia repair**<br><br>**Laproscopic (elective, high risk or cholecystectomy**<br>**bariatric surgery**<br>**Whipple procedure** | ☐ Cefazolin 2 g IV stat (weight≤120 kg)<br><br>☐ Cefazolin 3 g IV stat for weight ≥ 120kg)<br><br>☐ Children dose: Cefazolin 30mg/kg) IV single dose **PLUS**<br><br>☐ Metronidazole 500mg IV stat<br>☐ Children Metronidazole dose:15mg/kg IV,<br>**single dose completely infused 60 minutes prior to incision**<br><br>☐ For colorectal surgery: In addition to systemic antibiotics and mechanical bowel preparation (if no contraindication), the following oral antibiotic regimen is administered:<br>☐ Neomycin 1 g of PO PLUS<br>☐ Erythromycin base 1 g at 1 PM, 2 PM, and 11 PM, OR<br>☐ Neomycin 2 g PO PLUS<br>☐ Metronidazole 2 g PO at 7 PM and 11 PM the day before an 8 AM operation.<br>☐ Cefazolin 2g (wight≥120 kg: 3g) (children dose: 30mg/kg) IV single dose<br>☐ Cefazolin 2g (wight≥120 kg: 3g) IV single dose **PLUS**<br>☐ Metronidazole 500mg (children dose:15mg/kg, 7.5mg/kg if < 1.2kg) IV **single dose completely infused 60 minutes prior to first incision** | ☐ Metronidazole 500mg IV<br>☐ Children dose:15mg/kg, IV single dose **PLUS**<br>☐ Gentamicin 4.5 mg/kg IV<br>☐ Children gentamicin dose 2.5mg/kg IV **single dose completely infused 60 minutes prior to incision**<br><br>☐ Vancomycin IV 15-20 mg/kg q8h (target trough 15-20/ml) **single dose completely infused 120 minutes prior to first incision**<br>☐ Caculated vancomycin dose……..<br>**OR**<br>☐ Clindamycin 900mg<br>☐ Children dose: 10mg/kg) IV **PLUS**<br>☐ Ciprofloxacin 400mg IV<br>☐ Children dose: 10mg/kg) **single dose completely infused within 120 minutes prior to first incision** |
| **Cardiothoracic** | ☐ Cefazolin 2 g IV stat (weight≤120 kg)<br><br>☐ Cefazolin 3 g IV stat for weight ≥ 120kg)<br>☐ Children dose: Cefazolin 30mg/kg) IV **single dose completely infused 60 minutes prior to incision** | ☐ Vancomycin IV 15-20 mg/kg q8h (target trough 15-20/ml) single dose completely infused 120 minutes prior to first incision<br><br>☐ Caculated vancomycin dose…….. |

| | | |
|---|---|---|
| - **Cesarean delivery**<br>- **Vaginal or abdominal hysterectomy/other**<br>- **Obstetric procedure**<br><br>- **Abortion, surgical** | □ Cefazolin 2 g IV stat (weight≤120 kg)<br>□ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision**<br><br>☐ Doxycycline 100 mg orally one hour before procedure and 200 mg orally after procedure | ☐ Clindamycin 900mg IV **PLUS**<br>☐ Gentamycin 4.5 mg/kg **single dose completely infused 60 minutes prior to incision**<br><br>☐ Vancomycin 1 g IV **single dose completely infused 120 minutes prior to incision**<br><br>☐ Metronidazole 500 mg orally twice daily for five days. |
| **Head / Neck** | □ Cefazolin 2 g IV stat (weight≤120 kg)<br>□ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision OR**<br><br>☐ Cefuroxime 1.5 gm IV as single dose **PLUS**<br>☐ Metronidazole 500 mg IV as a single dose for clean-contaminated surgery | ☐ Clindamycin 900mg IV stat<br>☐ Children Clindamycin dose:10mg/kg IV single dose **PLUS**<br>☐ Gentamycin 4.5 mg/kg<br>☐ Children Gentamicin dose: 2.5mg/kg) **single dose completely infused 60 minutes prior to incision** |
| **Neurosurgery: Elective craniotomy and cerebrospinal fluid-shunting Procedures, Implantation of intrathecal pumps** | □ Cefazolin 2 g IV stat (weight≤120 kg)<br>□ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision** | ☐ Clindamycin 900mg IV stat<br>☐ Children Clindamycin dose:10mg/kg IV single dose<br>☐ If MRSA colonization is present:<br>☐ Vancomycin 1 g IV stat<br>☐ Children Vancomycin dose:15mg/kg IV **single dose completely infused 120 minutes prior to incision** |
| **Orthopedic (spinal procedure with or without instrumentation)**<br><br>**Joint replacement & limb amputation** | □ Cefazolin 2 g IV stat (weight≤120 kg)<br>□ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision** | ☐ Vancomycin 1 g IV stat<br>☐ Children Vancomycin dose:15 mg/kg IV **single dose completely infused within 120 minutes prior to incision** |
| **Vascular** | □ Cefazolin 2 g IV stat (weight≤120 kg)<br>□ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision** | ☐ Vancomycin 1 g IV stat<br>☐ Children Vancomycin dose:15 mg/kg IV **single dose completely infused within 120 minutes prior to incision** |

| | | |
|---|---|---|
| **Genitourinary: open or laparoscopic including percutaneous renal surgery.**<br><br>**Cystoscopy with manipulation or upper tract instrumentation.**<br><br>**or Cystoscopy alone but with positive urine cultures or preoperative catheter, transrectal prostatic biopsy, or placement of prosthetic material** | □ Cefazolin 2 g IV stat (weight≤120 kg)<br>□ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision**<br><br>☐ Ciprofloxacin 500 mg orally **OR**<br>☐ Ciprofloxacin 400 mg IV | ☐ Ciprofloxacin 400mg (children dose:10mg/kg) IV single dose completely infused 120 minutes prior to incision<br><br>☐ Trimethoprim-sulfamethoxazole Once 160/800 mg (double strength, DS) tablet orally |
| **Plastic** | Clean with risk factors or clean-contaminated<br><br>□ Cefazolin 2 g IV stat (weight≤120 kg)<br><br>□ Cefazolin 3 g IV stat for weight ≥ 120kg) **single dose completely infused 60 minutes prior to incision** | ☐ Clindamycin 900mg IV stat<br>☐ Children Clindamycin dose:10mg/kg IV single dose OR<br><br>☐ Vancomycin 1 g IV stat<br><br>☐ Children Vancomycin dose: 15 mg/kg) IV **single dose within 120 minutes prior to incision** |
| **Ophthalmic** | □ Topical Moxifloxacin 1 drop every 5–15 min for 5 doses at the end of procedure<br><br>□ Cefazolin 100 mg by subconjunctival injection | ☐ Cefazolin 1–2.5 mg Intracameral |

Physician Name: _____ pager/ mobile: _____
Physician signature: _____
Nurse name: _____ Nurse signature: _____
Date: ___/___/____ Time: _____ AM/PM

Physician/Pharmacist
Note:_____
_____
_____

# Appendix I, Antimicrobial Stewardship strategies

**Core strategies**

*Prospective audit with intervention and feedback*

It is a method that allows the antimicrobial steward (clinical pharmacist, or infectious diseases specialist) to interact directly with prescribers to modify specific antibiotic therapy for each patient. These strategies are employed after the initial prescribing and dispensing of the antibiotic, also named post-prescription review or back-end strategy.

*Formulary restriction and preauthorization*

It is a method that requires pre-authorization or approval of certain group of antimicrobial drugs named restricted antimicrobials, (usually broad spectrum with high potential of resistance emergence and high cost) before the pharmacy can dispense or after the first few doses have been dispensed. The prescriber will be notified to get infectious diseases or stewardship pharmacist's approval once these drugs are prescribed. (Appendix 2)

**Supplemental Antimicrobial Stewardship Strategies**

Education

Education alone, without incorporation of active intervention, is only marginally effective in changing antimicrobial prescribing practices and has not demonstrated a sustained impact

Guidelines and clinical pathways

Guidelines are means to standardise clinical practice and avoid misuse and overuse of antimicrobial therapy. They serve as tool guiding prescribers who lack competencies for antimicrobial prescription.

The current guidelines in this manual is put in order forms to enhance the adherence to them. Guideline implementation can be facilitated through stakeholders' engagement at the inception phase.

Guidelines must consider local or regional epidemiology and antimicrobial resistance.

Clinical pathways are efficient method to guide the healthcare provider in the management of variety of infectious diseases. Hospitals may adopt their own pathways according to the availability of antimicrobial drugs in the formulary.

Use of antimicrobial order forms with optimal timing and duration can assist pharmacist to automatic discontinuation when the predefined duration is completed.

Combination empirical therapy and de-escalation strategy

The guideline recommended combination antimicrobial therapy of broad-spectrum agents for empiric treatment of serious infections to improve clinical outcomes and target the most likely pathogen but de-escalation is encouraged within 48-72 hours once microbiology culture result is available to decrease antimicrobial exposure which drives resistance; this will result in substantial cost savings.

Conversion from IV to PO therapy

A systematic plan for parenteral to oral conversion of antimicrobials with excellent bioavailability, when the patient's condition allows, can decrease length of hospital stay and health care costs

Development of clinical criteria and guidelines allowing conversion to use of oral agents can facilitate implementation at the institutional level (Appendix 3)

Antimicrobial dose optimization

All the following should be considered during antibiotics prescribing:

*Dose optimization* (pharmacokinetics/pharmacodynamics) is essential to optimize the treatment of organisms with reduced susceptibility

*Therapeutic Drug Monitoring* for vancomycin and aminoglycoside (Appendix 4, 5)

*Dose adjustments* in cases of renal dysfunction (Appendix 6)

Surveillance of antimicrobial resistance

The antibiotic policy shall depend heavily on surveillance of antimicrobial resistance and antibiotic consumption (Appendix 7) in any setting. Hence, it is mandatory to establish an efficient surveillance system.

resistance containment strategies.

The clinical microbiology laboratory plays a critical role in antimicrobial stewardship by providing patient-specific culture and susceptibility data; as well as cumulative institution-wide and unit-based data (antibiogram) which will guide prescribers on making smart choices of empiric antimicrobial therapy.
The pharmacy department is responsible for antibiotics consumption at all hospital settings, ICU, non-ICU, Outpatient …etc

Computer Surveillance and Decision Support
(Note: the antimicrobial order form should be electronic unless the electronic prescription system does not exist in the hospital setting)
Health care information technology in the form of electronic medical records, computerized physician order entry (CPOE), and clinical decision support can improve antimicrobial decisions through the incorporation of data on patient-specific microbiology cultures and susceptibilities, hepatic and renal function, drug-drug interactions, allergies, and cost
Computer-based surveillance can facilitate good stewardship by more efficient targeting of antimicrobial interventions, tracking of antimicrobial resistance patterns, and identification of nosocomial infections and adverse drug events.

# Appendix II, Restricted Antimicrobial Agents

## Definition

Restricted antimicrobial agent is an agent which requires -prior to dispensing- authorization by the infectious Diseases (ID) physicians, other authorized personnel such as antimicrobial stewardship clinical pharmacist, or approved protocol by the antimicrobial stewardship committee. Depending on the hospital's policy, the first few doses may be allowed to be dispensed without authorization.

The following is a common restricted list of antimicrobial therapy

**Restricted antimicrobial classes**

**I. Antibacterial agents**

1. Amikacin
2. Ceftazidime
3. Cefepime
4. Colistin
5. Daptomycin
6. Doxycycline IV
7. Linezolid
8. Imipenem
9. Meropenem
10. Mupirocin
11. Rifampicin
12. Sulfadiazine
13. Tigecycline
14. Tobramycin
15. Ethionamide

**II. Antifungal drugs**

1. Liposomal Amphotericin B
2. Anidulafungin
3. Caspofungin
4. Posaconazole
5. Voriconazole

**III. Antiviral**

1. HIV medicines
2. Cidofovir
3. Ganciclovir
4. Foscarnet
5. Oseltamivir
6. Ribivarin

**IV. Antiprotozoal**

1. Artesunate
2. Atovaquone proguanil
3. Pyrimethamin
4. Pentamidine (systemic and inhalation)
5. Quinidine

# Appendix III, Switching IV antimicrobial to PO

## Background

### Why Switch From Intravenous to Oral Antibiotic Therapy?

To manage serious infections in hospital most clinicians use intravenous (IV) antibiotics initially to ensure an optimal concentration of antibiotic at the site of infection. Inappropriate antibiotic use is recognised as a key driver of antimicrobial resistance. Unnecessarily prolonged courses of IV antibiotics are also associated with increased length of hospital stay, increased costs of nursing, pharmacy and medical time in the insertion of IV lines, preparation, dispensing and administration of IV agents and the increased morbidity and mortality associated with IV line infections [1-3].

To optimise antibiotic use, a switch from IV antibiotics to oral therapy in the appropriate patient has a number of advantages. These include a shorter length of hospital stay with the associated reduction in morbidity and mortality, a reduction in staff workload and a reduction in antibiotic costs [1, 4-6].

### When to Switch

The optimal time to consider switching a patient to oral therapy is after 2 to 4 days of intravenous therapy. This period of time allows the clinician to evaluate the patient's microbiology results and assess their response to treatment. A large number of clinical trials support the early switching to oral antibiotics after this period of time with equal treatment efficacy and no adverse effects on patient outcome [2, 3, 7].

The flow chart in this guideline aids the clinician in deciding if it is safe to switch a patient to oral antibiotics. A patient must meet a number of criteria prior to switching:

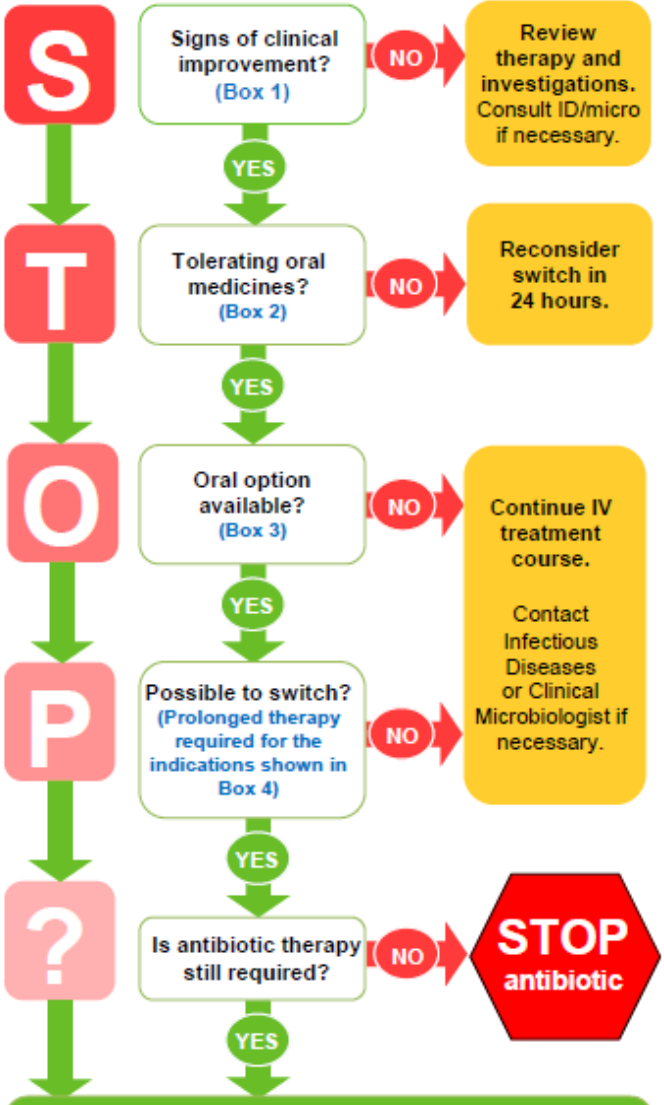
- Display signs of clinical improvement (Box 1)
- Able to tolerate oral therapy (Box 2)
- Not have a condition in which higher concentrations of antibiotic are required in the tissue or a prolonged course of IV therapy is essential (Box 4)

There are a number of conditions in which a switch to oral therapy should be considered including:

- Pneumonia
- Skin and soft tissue infections
- Urinary tract infections
- Uncomplicated Gram negative bacteraemia
- Intra-abdominal infection without deep seated collections

## Pathway / Protocol

**Patients who have negative blood cultures and have received ≥ 48 hours of IV therapy may be eligible to STOP or switch to oral therapy.**
**Use this guideline to select appropriate patients - important exclusions apply (see Box 4).**




### Box 1
**Signs of clinical improvement**

- Afebrile (temp >36°C and <38°C for past 48 hours)
- CRP trending down
- Stable immune response (WCC > 4 and <12 x $10^9$ cells/L or trending towards normal range)
- No unexplained tachycardia
- No unexplained hypotension
- No tachypnoea

### Box 2
**Tolerating oral medicines**

- Patient is not nil by mouth
- Patient is tolerating oral food or enteral feeding •
- Oral absorption is not compromised (e.g. diarrhoea, vomiting, malabsorptive disorder, unconscious, swallowing disorder)

• *Enteral feeding: consult pharmacy for advice on suitable formulation and administration method.*

### Box 3
**Common oral antibiotic options**

Use the following guide to select appropriate oral therapy
Note: Doses provided are for normal renal function – refer to the *Australian Medicines Handbook* or the *Therapeutic Guidelines: Antibiotic* for dosing in renal impairment

| Current IV therapy | Oral option (adult dose) |
|---|---|
| Amoxicillin 500mg-1g tds | Amoxicillin 500mg-1g tds |
| Amoxicillin with clavulanic acid 1.2g tds | Amoxicillin 875mg with clavulanic acid 125mg bd |
| Benzylpenicillin 600mg-1.2g qid | Amoxicillin 500mg-1g tds |
| Ceftriaxone 1g-2g daily | Amoxicillin 875mg with clavulanic acid 125mg bd^ |
| Cefazolin 1g-2g tds | Cefalexin 500mg-1g qid |
| Ciprofloxacin 200mg-400mg bd | Ciprofloxacin 500mg-750mg bd |
| Clindamycin 600mg tds | Clindamycin 150mg-450mg tds |
| Flucloxacillin 1g-2g qid | Di/Flucloxacillin 500mg-1g qid |
| Metronidazole 500mg bd | Metronidazole 400mg bd or tds |
| Piperacillin with tazobactam 4.5g tds or qid | Amoxicillin 875mg with clavulanic acid 125mg bd **Pseudomonas**: Seek advice from Clinical Microbiology or Infectious Diseases |
| Amoxycillin + gentamicin ± metronidazole | Amoxycillin 875mg with clavulanic acid 125mg bd or 500/125mg bd or tds |
| Cefepime, gentamicin, meropenem, vancomycin | Seek advice from Clinical Microbiology or Infectious Diseases |
| **The following IV drugs have equivalent oral doses:** Azithromycin, Linezolid, Fluconazole, Trimethoprim/Sulfamethoxazole | |

^ Consider patient allergy status when converting to a penicillin.

### Box 4
**Prolonged parenteral therapy is required for the following indications**

- Deep-seated infection e.g. abscess/empyema
- Meningitis or encephalitis
- Necrotising soft tissue infection
- Infected implant or prostheses
- *Staphylococcus aureus* bacteraemia
- Osteomyelitis
- Septic arthritis
- Endocarditis

# Appendix IV, Therapeutic Drug Monitoring for Aminoglycosides dosing

Aminoglycosides fight against bacteria by interfering with bacterial protein synthesis, which is achieved through irreversible binding to 30S ribosomal subunit.

Aminoglycosides have bactericidal activity against aerobic Gram-negative infections and demonstrates concentration-dependent killing with a prolonged PAE (~4-6 hours).

The best pharmacodynamics parameter to determine the ideal dosing regimen is peak/MIC ratio

Dosing weight: ideal body weight (IBW) unless 20% over IBW (use adjusted body weight instead)

Initial dosing: dependent on traditional versus extended interval dosing

Extended interval dosing in all patients* except patients with altered pharmacokinetics using Traditional dosing

Burns > 20%

- Morbidly obese
- Pregnancy
- Ascites or significant third spacing
- Hemodynamic instability
- Unstable renal function and cystic fibrosis

*Rationale: maximize concentration-dependent killing and minimize toxicity (i.e., nephrotoxicity and ototoxicity), ease of administration and monitoring, reductions in administration and monitoring-related costs.

### Aminoglycoside Monitoring:

| Site of Infection or Indication | Gram-positive infections (synergy) | Gram-negative infections (sepsis/pneumonia) |
|---|---|---|
| Gentamicin/Tobramycin | | |
| **Traditional initial dose** | **1 mg/kg/dose** | **1.5-2 mg/kg/dose** |
| Desired peak | 3-5 mg/L | 8-10 mg/L (10-12 times MIC of infecting organism) |
| Desired trough | < 1 mg/L | < 2 mg/L |
| **Extended interval dose** | NA | **7 mg/kg/dose** |
| Desired peak | NA | 10-12 times MIC of infecting organisms |
| Desired trough | NA | < 1 mg/L |
| Amikacin | | |
| **Traditional initial dose** | NA | **7.5 mg/kg/dose** |
| Desired peak | NA | 30-40 mg/L |
| Desired trough | NA | < 7 mg/L |
| **Extended interval dose** | NA | **15 mg/kg/dose** |
| Desired peak | NA | 10-12 times MIC of infecting organisms |
| Desired trough | NA | < 7 mg/L |

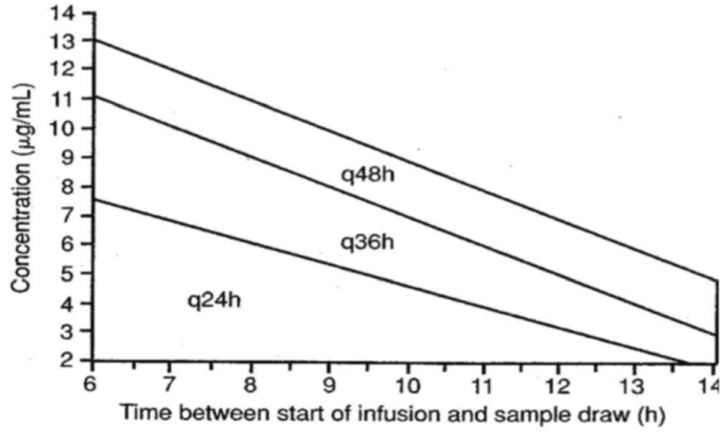
Traditional Dosing:

- Obtain serum peak and trough concentrations after 3rd dose following initiation of therapy and any dosing adjustments in therapy.
- Draw trough concentration just prior to next dose.
- Draw peak concentration 30-45 minutes after the end of an intravenous infusion.
- Once achieved, monitor periodically (e.g., 2-3 times weekly) throughout therapy with changes in renal function.
- If stable renal function, monitor at least once weekly.

Extended Interval Dosing:

- Random serum concentration monitoring approximately 6-12 hours after 1st dose. Interpret by using an established nomogram or based on MIC data. For amikacin therapy, divide serum concentration by 2 before using nomogram.
- Monitor periodically if unstable renal function or prolonged therapy (> 7-10 days).

**Figure 2.** Hartford nomogram (based on 7 mg/kg dosing)[7]



## Appendix V Therapeutic Drug Monitoring for Vancomycin

**Generic and Brand Name of Drug:** Vancomycin (Vancolon® )

**Reason(s) for Guidelines:** To provide guidelines for safe and effective dosing of vancomycin.

**Prescribing Restrictions:** Not restricted.

**Use:**

I.V.: Treatment of patients with infections caused by staphylococcal species and streptococcal species
Oral: Treatment of *C. difficile*-associated diarrhea and treatment of enterocolitis caused by *Staphylococcus aureus* (including methicillin-resistant strains)

**Vancomycin Dosing For Adults:**
Vancomycin dosing is based on the patient's **actual body weight** and requires adjustment inpatients with renal dysfunction.

**1. Estimate patient's creatinine clearance (CrCL)**

$$\text{CrCL (male) ml/min} = \frac{(140 - \text{age}) \times \text{TBW (kg)}}{72 \times \text{Scr}} \quad (\times 0.85 \text{ for females})$$

| **Creatinine Clearance** (based on Cockcroft and Gault) | **Dose*** | **Recommendation** |
|---|---|---|
| **>65 ml/min** | **Uncomplicated Infections:**<br>10-15 mg/kg q12h | **Trough levels:**<br><br>**(7-10mcmol/L)** |
| | **Serious Infections**: Consider **loading dose** of **25mg/kg IV once**, regardless of renal function<br><br>followed by:<br>15-20 mg/kg q8-12h<br><br>(45-60mg/kg/day divided q12h or q8h) | For patients with serious infections due to MRSA :<br>• CNS infections.<br>• Endocarditis.<br>• VAP.<br>• Bacteremia.<br>• Osteomyelitis.<br>**Trough levels :**<br>**(10-14mcmol/L)**<br>**ID CONSULT IS RECOMMENDED. |
| **40-65 ml/min** | 10-15 mg/kg q12h-q24h | |
| **20-40 ml/min** | 5-10 mg/kg q24h | |
| **10-20 ml/min** | 5-10 mg/kg q24h-q48h | |
| **<10 ml/min** | 10 - 15 mg/kg IV loading dose once; then 500 mg every 48 to 96 hours based on trough level | |

**Dosing adjustment in renal impairment with dialysis:**

| | |
|---|---|
| **Intermittent hemodialysis (IHD)** | |
| **Intermittent hemodialysis (IHD)** | Following loading dose, give 1000-1500 mg **then** 5-10 mg/kg after each dialysis session<br>** based on pre dialysis concentration |
| **Re-dosing based on pre-HD concentrations:** | If Vancomycin serum trough concentration is:<br>< (7**mcmol/L**): Administer 1000 mg after HD<br>7-17**mcmol/L**: Administer 500-750 mg after HD<br>> 17**mcmol/L**: Hold vancomycin, & do random vancomycin level |
| **Redosing based on post-HD concentrations** | < 7-10**mcmol/L**: Administer 500-1000 mg |
| **Continuous renal replacement therapy (CRRT)*** ** | |
| **CVVH** | Loading dose of 15-25 mg/kg, followed by either 1000 mg every 48 hours **or** 10-15 mg/kg<br>every 24-48 hours |
| **CVVHD** | Loading dose of 15-25 mg/kg, followed by either 1000 mg every 24 hours **or** 10-15 mg/kg<br>every 24 hours |
| **CVVHDF** | Loading dose of 15-25 mg/kg, followed by either 1000 mg every 24 hours **or** 7.5-10 mg/kg<br>every 12 hours. |

**Note:**

**Dosing dependent on the assumption of 3 times/week, complete IHD sessions.

***For CRRT:vancomycin maintenance dose based on random vancomycin trough concentration, target level concentrations <7-10**mcmol/L**or 10-14**mcmol/L**.

**Dosing for Pediatrics:**

1. **Empiric Dosing for infants > 1 month and Children:**
   - Non-meningitis Infections: 10 mg/kg up to a maximum of 1,000 mg every 6 hours.
     Dosages of greater than 500 mg should be run over two (2) hours.
   - Meningitis: 15 mg/kg IV every 6 hours. Dosages of greater than 500mg should be run over two (2) hours.
   - Round dose to nearest 10mg.

2. **Empiric Dosing for Neonates:**
   - Meningitis: 15mg/Kg
   - Bacteremia: 10mg/Kg
   - Round dose to nearest 5mg

| Postconceptional Age | Chronological Age | Dose Dosing | Interval |
|---|---|---|---|
| < 29 weeks | 0-14 days | 10 – 15 mg/kg | q 18 hours |
| | > 14 days | 10 – 15 mg/kg | q 12 hours |
| 30 to 36 weeks | 0 – 14 days | 10 – 15 mg/kg | q 12 hours |
| | > 14 days | 10 – 15 mg/kg | q 8 hours |
| 37 to 44 weeks | 0 – 7 days | 10 – 15 mg/kg | q 12 hours |
| | > 7 days | 10 – 15 mg/kg | q 8 hours |
| > 45 weeks | All | 10 – 15 mg/kg | q 6 hours |

3. **Pediatric Creatinine Clearance:**
Schwartz equation:CrCL = K x length in cm/Scr (mg/dl)

| Age | K |
|---|---|
| Low birth weight ≤ 1 year | 0.33 |
| Full – term ≤ 1 year | 0.45 |
| 2 -12 years | 0.55 |
| 13 – 21 years - FEMALE | 0.55 |
| 13 – 21 years - MALE | 0.7 |

4.**Dosage Adjustments Based on Renal Function:**

| CrCl (mL/min) | Dosing Interval |
|---|---|
| > 90mL/min | q 6-8 hours |
| 70-89 mL/min | q 8 hours |
| 46-69 mL/min | q 12 hours |
| 30-45 mL/min | q 18 hours |
| 15-29 mL/min | q 24 hours |
| < 15 mL/min | Dose & interval based on levels |

**Monitoring Parameters**

**A.** Periodic renal function tests, urinalysis, WBC; serum trough vancomycin concentrations in select patients.

**B. Therapeutic Drug Monitoring:**

| Monitoring | Recommendation |
|---|---|
| **Trough serum concentration monitoring** | • The most accurate and practical method for monitoring efficacy.<br>• Recommended for patients :<br>o Requiring therapy > 4 days<br>o With severe or life threatening infections<br>o Receiving concomitant nephrotoxic drugs (e.g. cyclosporine, amphotericin B, aminoglycosides)<br>o Aggressive dosing.<br>o unstable renal function.<br>o morbidly obese |
| **Sample Time** | Trough levels should be obtained within 30 minutes before 4th dose of a new regimen or dosage change. |
| **Short duration of therapy (≤ 3 days)** | Vancomycin troughs are not recommended in those patients |
| **Oral vancomycin therapy Difficile –associated diarrhea** | Vancomycin troughs are not recommended in those patients |
| **Patients with stable renal function and clinical status** | Once weekly monitoring is reasonable. |
| **Hemodynamically unstable** | Draw trough concentrations more frequently or in some instances daily. |
| **Hemodialysis** | Trough levels are recommended for routine monitoring (for intermittent hemodialysis, a pre-dialysis level should be drawn). |
| **Random concentrations ONLY if:** | - Severe renal dysfunction or on dialysis.<br>- Obtain a level after 3-4 days of therapy. More frequent sampling is usually not necessary.<br>Re-dose when serum level ≤15 mcg/mL.( ≤10mcmol/L) |

**Trough Target Concentration:**

| Type of Infection | Target Trough Concentration |
|---|---|
| **Soft skin tissue infections , Abscess, cellulitis** (MIC <1 mg/L) | 10-15 mg/L(**7-10mcmol/L**) |
| **Soft skin tissue infections , Abscess, cellulitis** (MIC >1 mg/L) | 15 – 20 mg/L(**10-14mcmol/L**) |
| **Complicated infections (endocarditis, osteomyelitis, bacteremia, prosthetic joint infection, or Pneumonia)** | 15 – 20 mg/L(**10-14mcmol/L**) |
| **Infection involving central nervous system ( meningitis)** | 20-25 mg/L(**14-17.5 mcmol/L**) |

**Reconstitution and Administration:**

- **Concentration less than or equal to 5 mg/ml**
  [0 to 500 mg] [100 ml] [ 30 minutes ]
  [501-1250 mg] [250 ml] [ 60 minutes ]
  [1251-1750mg] [500ml] [ ≥90 minutes ]
  [1751-2250mg] [500 ml] [ ≥120 minutes ]

- **Concentration less than or equal to 2.5 mg/ml**
  [0 to 250 mg] [100 ml] [30 minutes]
  [251 - 625 mg] [250 ml] [60 minutes]
  [626 - 1250mg] [500ml] [≥ 90 minutes ]

**Common Adverse Reactions:**red neck or red man syndrome - infusion rate related
**Rare/Serious Adverse Reactions:**

- **Hematologic:** Agranulocytosis, Neutropenia, Thrombocytopenia
- **Immunologic:** Anaphylaxis, Drug hypersensitivity syndrome
- **Otic:** Ototoxicity
- **Renal:** Nephrotoxicity

**Drug Interactions Drug-Drug Combinations:**
Amikacin,Gentamicin,Tobramycin,Warfarin

**Special Comments/ Instructions:**

1. Assess results of culture and sensitivity tests and patient's allergy history prior to first dose.
2. Use caution with renal impairment or previous hearing loss.
3. Premedication with antihistamines may prevent or minimize "red man" reaction.
4. Infusion site must be monitored closely to prevent extravasation.
5. Monitor for hypotension, rash, neutropenia, nausea, vomiting, and auditory changes on a regular basis during therapy.
6. Vancomycin dosages should be calculated on ABW. For obese patients, initial dosing can be based on ABW and then adjusted based on serum vancomycin concentrations to achieve therapeutic levels.forMorbidly obese patients Adjusted Body weight should be used instead.

**Refrences:**


1. Lexi-Comp®
2. Micromedex®
3. Thomson AH., et.al, Development and evaluation of vancomycin dosage guidelines designed to achieve new target concentrations. J AntimicrobChemother. 2009 May;63(5):1050-7.
4. Peter J. Ambrose and Michael E. Winter. Chapter 15 Vancomycin. In: Michael E. Winter, Basic Clinical Pharmacokinetics 4th edition. Philadelphia Lippincott Williams & Wilkins 2004, 451-475
5. Trotman RL, Williamson JC, et al. Antibiotic Dosing in Critically ill adult patients receiving CRRT. Clinical Infectious Disease 2005:41 1159 – 1166.
6. Pediatric Dosage Handbook, 12th edition, 2005-2006.
7. Rybak MJ, LomaestroBM,Therapeutic monitoring of vancomycin in adults summary of consensus recommendations from the American Society of health-system pharmacists, the infectious diseases society of America, and the society of infectious diseases pharmacists. Pharmacotherapy. 2009 Nov;29(11):1275-9.
8. American Society of Health-System Pharmacists 2011

# Appendix VI, DOSE ADJUSMENT IN RENAL DYSFUNCTION

**Formulas for dosing weights:** Ideal body weight IBW (male) = 50kg + (2.3 x height in inches > 60 inches) · Ideal body weight IBW (female) = 45kg + (2.3 x height in inches > 60 inches) · Adjusted Body Weight ABW (kg) = IBW + 0.4 (TBW – IBW)

<table>
<tr><th>Drug</th><th>CrCl > 50 mL/min</th><th>CrCl 10 – 50 mL/min</th><th>CrCl < 10 mL/min</th><th>Intermittent Hemodialysis (IHD)</th><th>CRRT</th></tr>
<tr><td>Acyclovir (IV)<br>(Use adjusted BW for obese)</td><td>HSV: 5 mg/kg q8h<br>HSV encephalitis/zoster: 10 mg/kg q8h</td><td>Same dose<br>CrCl 25 – 50: q12h<br>CrCl 10 – 25: q24h</td><td>HSV: 2.5 mg q24h<br>HSV encephalitis/zoster: 5 mg/kg q24h</td><td>HSV: 2.5 mg/kg q24h<br>HSV encephalitis/zoster: 5 mg/kg q24h<br>Dose daily, but after HD on HD</td><td>CVVH: 5 – 10 mg/kg q24h<br>CVVHDF: 5 – 10 mg/kg q12h<br>HSV encephalitis/zoster: 10 mg/kg q12h</td></tr>
<tr><td>Acyclovir (PO)</td><td colspan="3"><table><tr><th></th><th>CrCl > 25</th><th>CrCl 10 – 25</th><th>CrCl < 10</th></tr><tr><td>HSV mucocutaneous</td><td>400 mg q8h<br>Alt: 200 mg 5x daily</td><td>200 mg q8h</td><td>200 mg q12h</td></tr><tr><td>VZV</td><td>800 mg q4h (or 5x daily)</td><td>800 mg q8h</td><td>800 mg q12h</td></tr></table></td><td>See CrCl < 10 mL/min</td><td>No data</td></tr>
<tr><td>Amikacin<br>(Use adjusted BW in obese)</td><td colspan="3"><table><tr><th></th><th>CrCl > 60</th><th>CrCl 40 – 60</th><th>CrCl 20 – 40</th><th>CrCl < 20</th></tr><tr><td>Conventional dosing</td><td>5 – 7.5 mg/kg q8h</td><td>5 – 7.5 mg/kg q12h</td><td>5 – 7.5 mg/kg q24h</td><td rowspan="2">5 mg/kg load, then by level<br>alt: 7.5 mg/kg q48–72h</td></tr><tr><td>High-dose extended-interval dosing</td><td>15 – 20 mg/kg q24h</td><td>15 mg/kg q36h</td><td>CrCl > 30: 15 mg/kg q48h<br>CrCl < 30: Not recommended</td></tr></table>Timing of levels: Draw trough 30 min prior to 4th dose. Draw peak 30 min after infusion ends<br>Once daily dosing: goal peak 35 – 60 mcg/mL; goal trough < 4 mcg/mL<br>Conventional dosing: goal peak 25 – 35 mcg/mL for serious infections; 15 – 20 mcg/mL for UTI; goal trough < 4 – 8 mcg/mL</td><td>5 – 7.5 mg/kg post HD only<br>consult pharmacist</td><td>10 mg/kg load, then 7.5 mg/kg q24–48h<br>Severe/MDR organism: 25 mg/kg q48h<br>consult pharmacist</td></tr>
<tr><td>Amoxicillin (PO)</td><td>Usual dose: 250 – 500 mg q8h or 875 mg q12h<br>H pylori: 1,000 mg q12h<br>Procedural ppx: 2,000 mg x 1</td><td>CrCl 10–30: 250 – 500 mg q12h</td><td>250 – 500 mg q24h</td><td>250 – 500 mg q24h; administer additional dose at the end of dialysis</td><td>No data</td></tr>
<tr><td>Amoxicillin/clavulanate (PO)</td><td>Usual dose: 250 – 500 mg q8h or 875 mg q12h<br>CAP: 2,000 mg ER q12h</td><td>CrCl <30: Do not use 875 mg tablet or ER tab<br>CrCl 10 – 30: 250 – 500 mg q12h</td><td>250 – 500 mg q24h</td><td>250 – 500 mg q24h; administer additional dose at the end of dialysis</td><td>No data</td></tr>
<tr><td>Amphotericin B Liposomal<br>(Consider adjusted BW in obese)</td><td>3 – 6 mg/kg/day</td><td>No change</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Ampicillin (IV)</td><td>Mild/uncomplicated: 1 – 2 g q6h<br>Meningitis/endovascular/PJI: 2 g q4h</td><td>Mild/uncomplicated: 1 g q6–8h<br>Meningitis/endovascular /PJI: 2 g q6–12h</td><td>Mild/uncomplicated: 1 g q12h<br>Meningitis/endovascular /PJI: 2 g q12–24h; or 1 g q8h</td><td>Mild/uncomplicated: 1 g q12h<br>Meningitis/endovascular/PJI: 2 g q12–24h</td><td>CVVH: 2 g q8–12H<br>CVVHDF: 2 g q6–8h<br>Meningitis/endovascular /PJI: 2 g q6h</td></tr>
<tr><td>Azithromycin (IV/PO)</td><td>500 mg q24h</td><td>No change</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Aztreonam<br>Severe: pseudomonas, life-threatening infections</td><td>1 – 2 g q8h<br>Severe/Meningitis: 2 g q6–8h</td><td>CrCl < 30: 1 g q8h<br>Severe/Meningitis: 1 g q6–8h</td><td>500 mg q8h<br>Severe/Meningitis: 1g q12h</td><td>1 g q24h<br>Severe/Meningitis: 1 g q12h</td><td>2 g load, then 1 g q8h – or – 2 g q12h</td></tr>
<tr><td>Caspofungin</td><td colspan="3">70 mg x 1, then 50 mg q24h<br>Optional: 70 mg x 1, then 35 – 50 mg q24h if severe hepatic dysfunction/ESLD.<br>70 mg q24h if on phenytoin, rifampin, other strong enzyme inducers</td><td>No change</td><td>No change</td></tr>
<tr><td>Cefazolin</td><td>CrCl ≥ 35:<br>Mild/moderate: 1 g q8h<br>Severe: 2 g q8h</td><td>CrCl 10 – 34:<br>Mild/moderate: 0.5 g q12h<br>Severe: 1 g q12h</td><td>1 g q24h</td><td>1 g q24h<br>Dose daily, but after HD on HD days<br>alt: 2g/2g/3g post-HD only</td><td>2 g q12h</td></tr>
<tr><td>Cefepime</td><td colspan="3"><table><tr><th colspan="4">Extended Infusion (4-hour infusion)</th></tr><tr><th></th><th>CrCl > 60</th><th>CrCl 30 – 60</th><th>CrCl < 30</th></tr><tr><td>General</td><td>1 g q8h or 2 g q12h</td><td>1 g q12h or 2 g q24h</td><td>1 g q24h</td></tr><tr><td>CNS/FN</td><td>2 g q8h</td><td>2 g q12h</td><td>1 g q12h</td></tr></table>General: 0.5 g q24h<br>CNS/FN: 1 g q24h</td><td>0.5 – 1 g q24h<br>Dose daily, but after HD on HD days<br>alt: 2 g post-HD only</td><td>2 g load, then 1 g q8h – or – 2 g q12h</td></tr>
<tr><td>Ceftazidime (IV)</td><td>Usual dose: 1 – 2 g q8h<br>Severe: 2 g q8h</td><td>CrCl 30 – 50: 1 – 2 g q12h CrCl 16 – 30: 1 – 2 g q24h CrCl 6 – 15: 0.5 – 1 g q24h</td><td>CrCl < 5: 0.5 g q24h</td><td>0.5 – 1 g q24h<br>Dose daily, but after HD on HD days<br>alt: 1 – 2 g q48–72h or post-HD only</td><td>2 g load, then 1 g q8h – or – 2 g q12h</td></tr>
<tr><td>Ceftriaxone (IV)</td><td colspan="3">1 – 2 g q24h<br>Endovascular/osteomyelitis/PJI: 2 g q24h<br>Meningitis, E. faecalis endocarditis: 2 g q12h</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Cephalexin (PO)</td><td>250 – 1000 mg q6h<br>Uncomplicated cystitis: 500 mg q12h<br>Cellulitis/SSTI: 500 mg q6h</td><td colspan="2">CrCl 15 – 29: 250 mg q8–12h<br>CrCl 5 – 14: 250 mg q24h</td><td>500 mg q24h<br>Dose daily, but after HD on HD days</td><td>NO DATA</td></tr>
</table>

<table>
<tr><th>Drug</th><th>CrCl > 50 mL/min</th><th>CrCl 10 – 50 mL/min</th><th>CrCl < 10 mL/min</th><th>Intermittent Hemodialysis (IHD)</th><th>CRRT</th></tr>
<tr><td>Ciprofloxacin (IV/PO)</td><td colspan="3"><table><tr><td></td><td>CrCl > 50</td><td>CrCl 30 – 50</td><td>CrCl < 30</td></tr><tr><td>General infections</td><td>400 mg IV q12h<br>500 mg PO q12h</td><td>Same</td><td>400 mg IV q24h<br>500 mg PO q24h</td></tr><tr><td>Pseudomonas, severe</td><td>400 mg IV q8h<br>750 mg PO q12h</td><td>400 mg IV q8–12h<br>500 mg PO q12h</td><td>400 mg IV q24h<br>500 mg PO q24h</td></tr></table></td><td>200 – 400 mg IV q24h<br>250 – 500 mg PO q24h<br>Dose daily, but after HD on HD days</td><td>400 mg IV q12–24h<br>500 mg PO q12–24h<br><br>Septic pt > 90 kg on CVVHF/CVVHDF with A.baumannii or P.aeruginosa:<br>400 mg IV q12–8h</td></tr>
<tr><td>Clindamycin</td><td>600 – 900 mg IV q8h<br>150 – 450 mg PO q6h</td><td>No change</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Doxycycline (IV/PO)</td><td>100 mg q12h</td><td>No change</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Ertapenem (IV/IM)</td><td>1 g q24h</td><td>CrCl <30: 500 mg q24h</td><td>500 mg q24h</td><td>500 mg q24h<br>Dose daily, but after HD on HD days</td><td>1 g q24h</td></tr>
<tr><td>Ethambutol (PO)(Use lean BW if obese)</td><td>Dose range:<br>15 – 25 mg/kg/day<br>(max dose: 1,600 mg/day)<table><tr><td>Lean body weight</td><td>Dose</td></tr><tr><td>40 – 55 kg</td><td>800 mg</td></tr><tr><td>56 – 75 kg</td><td>1,200 mg</td></tr><tr><td>76 – 90 kg</td><td>1,600 mg</td></tr></table></td><td>CrCl 10 – 50:<br>15 – 25 mg/kg q24–36h</td><td>CrCl < 10:<br>15 – 25 mg/kg q48h</td><td>15 – 25 mg/kg 3 times per week post-HD<br>Administer after HD only</td><td>15 – 25 mg/kg q24–36h</td></tr>
<tr><td>Foscarnet (IV)<br>(Consider adjusted BW in obese)<br><br>Adj CrCl (mL/min/kg)<br>$\left(\frac{140 - age}{SCr \times 72}\right) \times (0.85 \text{ if female})$</td><td colspan="5"><table><tr><th>CrCl (mL/min/kg)</th><th colspan="2">CMV induction</th><th colspan="2">CMV maintenance</th><th colspan="2">HSV</th></tr><tr><td>> 1.4</td><td>60 mg/kg q8h</td><td>90 mg/kg q12h</td><td>90 mg/kg q24h</td><td>120 mg/kg q24h</td><td>40 mg/kg q12h</td><td>40 mg/kg q8h</td></tr><tr><td>> 1.0 – 1.4</td><td>45 mg/kg q8h</td><td>70 mg/kg q12h</td><td>70 mg/kg q24h</td><td>90 mg/kg q24h</td><td>30 mg/kg q12h</td><td>30 mg/kg q8h</td></tr><tr><td>> 0.8 – 1.0</td><td>50 mg/kg q12h</td><td>50 mg/kg q12h</td><td>50 mg/kg q24h</td><td>65 mg/kg q24h</td><td>20 mg/kg q12h</td><td>35 mg/kg q12h</td></tr><tr><td>> 0.6 – 0.8</td><td>40 mg/kg q12h</td><td>80 mg/kg q24h</td><td>80 mg/kg q48h</td><td>105 mg/kg q48h</td><td>35 mg/kg q24h</td><td>25 mg/kg q12h</td></tr><tr><td>> 0.5 – 0.6</td><td>60 mg/kg q24h</td><td>60 mg/kg q24h</td><td>60 mg/kg q48h</td><td>80 mg/kg q48h</td><td>25 mg/kg q24h</td><td>40 mg/kg q24h</td></tr><tr><td>≥ 0.4 – 0.5</td><td>50 mg/kg q24h</td><td>50 mg/kg q24h</td><td>50 mg/kg q48h</td><td>65 mg/kg q48h</td><td>20 mg/kg q24h</td><td>35 mg/kg q24h</td></tr><tr><td>< 0.4</td><td colspan="2">Not recommended</td><td colspan="2">Not recommended</td><td colspan="2">Not recommended</td></tr><tr><td>IHD</td><td colspan="2">60 – 90 mg/kg loading dose, then 45 – 60 mg/kg/dose post-HD only</td><td colspan="2">No data</td><td colspan="2">No data</td></tr><tr><td>CRRT</td><td colspan="6">No data</td></tr></table></td></tr>
<tr><td>Ganciclovir (IV)<br>(Consider adjusted BW in obese)</td><td colspan="3"><table><tr><td>CMV</td><td>CrCl >70*</td><td>CrCl >50</td><td>CrCl >25</td><td>CrCl >10</td><td>CrCl <10</td></tr><tr><td>Induction (I)</td><td>5 mg/kg q12h</td><td>2.5 mg/kg q12h</td><td>2.5 mg/kg q24h</td><td>1.25 mg/kg q24h</td><td>1.25 mg/kg 3x/week</td></tr><tr><td>Maintenance (M)</td><td>5 mg/kg q24h</td><td>2.5 mg/kg q24h</td><td>1.25 mg/kg q24h</td><td>0.625 mg/kg q24h</td><td>0.625 mg/kg 3x/week</td></tr></table>*Manufacturer's CrCl cutoffs. Please refer to BMT protocols if applicable</td><td>I: 1.25 mg/kg post HD only<br>M: 0.625 mg/kg post HD only</td><td>I: 2.5 mg/kg q12–24h<br>M: 1.25 – 2.5 mg/kg q24h</td></tr>
<tr><td>Gentamicin<br>(Use adjusted BW in obese)<br><br>See appendix for complete guidelines</td><td colspan="5"><table><tr><td></td><td>CrCl > 60</td><td>CrCl 40 – 59</td><td>CrCl 20 – 39</td><td>CrCl < 20</td><td>IHD</td><td>CRRT</td></tr><tr><td>Gram negative</td><td>1.7 mg/kg q8h<br>or<br>5 – 7 mg/kg q24h<br>(high-dose extended-interval)</td><td>1.7 mg/kg q12h<br>or<br>5 – 7 mg/kg q36h<br>(high-dose extended-interval)</td><td>1.7 mg/kg q24h<br>or<br>CrCl > 30: 5 – 7 mg/kg q48h<br>CrCl < 30: Not recommended<br>(high-dose extended-interval)</td><td>2 mg/kg loading dose, then per level</td><td>2 mg/kg loading dose, then 1.5 mg/kg post HD</td><td>1.5 – 2.5 mg/kg q24–48h</td></tr><tr><td>Gram positive synergy</td><td>1 mg/kg q8h**</td><td>1 mg/kg q12h</td><td>1 mg/kg q24h</td><td>1 mg/kg load, then by level</td><td>1 mg/kg q48–72h; consider redosing when level < 1 mcg/L</td><td>1 mg/kg q24h, then per level</td></tr></table>Goal levels: Gram-negative infections: Goal peak for traditional dosing 4 – 8 mcg/mL; goal trough < 1 – 2 mcg/mL<br>Gram-positive synergy: Goal peak 3 – 4 mcg/mL; goal trough < 1 mcg/mL<br>Timing of levels: Draw peak 30 minutes after completion of 3rd dose. Draw trough 30 minutes prior to 4th dose (For CrCl < 20 mL/min, may check levels sooner than 3rd/4th dose)<br>For 7 mg/kg once-daily dosing, draw a single random level 8 – 12 hours after dose administration. Adjust based on Hartford nomogram<br>For HD, draw trough pre-HD (alternative: draw trough level 4-hr post-HD); and peak 30 minutes after end of each infusion<br>** Streptococci, Streptococcus gallolyticus (bovis), Streptococcus viridans endocarditis: optional dosing 3 mg/kg q24h for CrCl > 60 mL/min<br>** Staphylococci; Enterococcus spp (strains susceptible to PCN and gentamicin) endocarditis: optional dosing 3 mg/kg in 2 or 3 equally divided doses</td></tr>
<tr><td>Linezolid (IV/PO)</td><td>600 mg q12h</td><td>No change</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Isoniazid (PO)</td><td>300 mg q24h<br>(5 mg/kg/day)</td><td>No change</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Levofloxacin (IV/PO</td><td colspan="3"><table><tr><td></td><td>CrCl ≥ 50</td><td>CrCl 20 – 49</td><td>CrCl < 20</td></tr><tr><td>General</td><td>250 – 500 mg q24h</td><td>250 mg q24h<br>- or -<br>500 mg q48h</td><td>500 mg x1,<br>then 250 mg q48h</td></tr><tr><td>Severe/PNA/ Pseudomonas/ Stenotrophomonas:</td><td>750 mg q24h</td><td>750 mg q48h</td><td>750 mg x1,<br>then 500 mg q48h</td></tr></table></td><td>See CrCl < 20 ml/min<br><br>Dose q48h, but after HD on HD days</td><td>750 mg load,<br>then 250 – 750 mg q24h</td></tr>
<tr><td>Meropenem<br>3-hr extended infusion</td><td colspan="3"><table><tr><td></td><td>CrCl > 50</td><td>CrCl 26 – 50</td><td>CrCl 10 – 25</td><td>CrCl < 10</td></tr><tr><td>Usual dose (FN, PNA, Pseudomonas)</td><td>0.5 – 1 g q8h</td><td>0.5 – 1 g q12h</td><td>0.5 g q12h</td><td>0.5 g q24h</td></tr><tr><td>CF/Meningitis</td><td>2 g q8h</td><td>2 g q12h</td><td>1 g q12h</td><td>1 g q24h</td></tr></table></td><td>500 mg q24h<br><br>CF/CNS: 1 g q24h<br><br>Dose daily, but after HD on HD days</td><td>1 g q8–12h<br>– or –<br>500 mg q6–8h<br><br>CF/CNS: 2 g q12h</td></tr>
</table>

<table>
<tr><th>Drug</th><th>CrCl > 50 mL/min</th><th>CrCl 10 – 50 mL/min</th><th>CrCl < 10 mL/min</th><th>Intermittent Hemodialysis (IHD)</th><th>CRRT</th></tr>
<tr><td>Metronidazole (IV/PO)</td><td>500 mg q6–8h</td><td colspan="2">No change<br>Severe hepatic impairment: can consider 500 mg q12h</td><td>500 mg q8h</td><td>500 mg q6–8h</td></tr>
<tr><td>Oseltamivir (PO)</td><td colspan="3"><table><tr><th></th><th>CrCl ≥ 60</th><th>CrCl 30 – 60</th><th>CrCl 10 – 30</th></tr><tr><td>Prophylaxis</td><td>75 mg q24h</td><td>30 mg q24h</td><td>30 mg q48h</td></tr><tr><td>Treatment</td><td>75 mg q12h</td><td>30 mg q12h</td><td>30 mg q24h</td></tr></table></td><td>Prophylaxis:<br>30 mg x 1, then 30 mg after every other HD session<br>Treatment:<br>30 mg x 1, then 30 mg post-HD only</td><td>Prophylaxis: 75 mg q24h<br>Treatment: 75 mg q12h</td></tr>
<tr><td>Moxifloxacin (IV/PO)</td><td>400 mg IV/PO q24h</td><td>No change</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Piperacillin/tazobactam</td><td colspan="3"><table><tr><th></th><th>CrCl > 40</th><th>CrCl 20 – 40</th><th>CrCl < 20</th></tr><tr><td colspan="4">Intermittent Dosing</td></tr><tr><td>General</td><td>3.375 g q6h</td><td>2.25 g q6h</td><td>2.25 g q8h</td></tr><tr><td>Severe/sepsis/CF/ nosocomial PNA</td><td>4.5 g q6h</td><td>3.375 g q6h</td><td>2.25 g q6h</td></tr><tr><td colspan="4">Extended-Infusion Dosing (4-hr infusion)</td></tr><tr><td>General, CF Pseudomonas, nosocomial PNA:</td><td colspan="2">Extended infusion for CrCl > 20:<br>3.375 – 4.5 g q8h over 4h*</td><td>3.375 g q12h over 4h</td></tr></table>*In select cases, higher piperacillin/tazobactam dosing may be warranted, e.g. sepsis, critically ill patients with severe or deep seated infections, infections with MIC > 16 mg/L, obesity with weight > 120kg or BMI > 40, CrCl > 120 mL/min, or enhanced drug clearance such as those with cystic fibrosis: consider doses of 4.5 g q8h (infused over 4 hours) or q6h.</td><td>General: 2.25 g q12h<br>Severe infections:<br>3.375 g q12h over 4-hr<br>alt: 2.25 g q8h</td><td>3.375 g q6h<br>Extended infusion:<br>3.375 – 4.5 g q8h over 4-hr</td></tr>
<tr><td>Penicillin G (IV)</td><td>2 – 4 mu q4h<br>Dose range: 12 – 24 million units/day continuous infusion or in divided doses every 4 to 6 hours</td><td>2 – 3 mu q4h</td><td>1 – 2 mu q6h</td><td>Mild: 0.5 – 1 mu q4–6h; or 1 – 2 mu q8–12h<br>Severe: 2 mu q4–6h; or 4 mu q8–12h</td><td>4 mu q4–6h</td></tr>
<tr><td>Posaconazole (PO/IV)</td><td colspan="3"><table><tr><th></th><th>Oral Suspension</th><th>Delayed-release tablet / Intravenous solution</th></tr><tr><td>Prophylaxis</td><td>200 mg q8h</td><td rowspan="2">300 mg q12h x 1 day, then 300 mg q24h</td></tr><tr><td>Treatment</td><td>Usual dose: 200 mg q6–8h or 400 mg q12h</td></tr></table>No renal adjustment<br>• Delayed-release tablet and oral suspension are not interchangeable<br>• Posaconazole levels shown to have great degree of interpatient variability. Consider drawing a trough 4 – 7 days after initiating dose</td><td>No change</td><td>No change</td></tr>
<tr><td>Pyrazinamide (PO)<br>(Use lean BW if obese)</td><td colspan="2">Usual Dose: 25 mg/kg q24h (max dose: 2,000 mg/day)<table><tr><th>Lean body weight</th><th>Dose</th></tr><tr><td>40 – 55 kg</td><td>1,000 mg</td></tr><tr><td>56 – 75 kg</td><td>1,500 mg</td></tr><tr><td>76 – 90 kg</td><td>2,000 mg</td></tr></table></td><td>CrCl < 30:<br>25 mg/kg 3 times per week</td><td>25 mg/kg 3 times per week<br>Administer after HD only</td><td>No data</td></tr>
<tr><td>Rifampin (IV/PO)<br>Capsule size: 150mg, 300mg</td><td colspan="2">TB: 600 mg q24h (≤ 45 kg: 10 mg/kg q24h)<br>Endocarditis: 300 mg q8h<br>PJI: 300 – 450 mg q12h<br>Vertebral Osteomyelitis: 600 mg q24h</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>Trimethoprim (TMP)/ Sulfamethoxazole (IV/PO)<br>(Dose by adjusted BW in obese)<br>SS = 80 mg TMP = 10 ml po soln<br>DS =160 mg TMP = 20ml po soln</td><td>Usual Dose Range:<br>PO: 1 – 2 DS tabs q12–24h<br>IV: 8 – 20 mg/kg/day TMP divided q6–12h<br>UTI: 1 DS tab PO BID SSTI: 1 – 2 DS tab PO BID<br>PCP/Stenotrophomonas: 15 – 20 mg/kg/day TMP divided q6–8h (approximately 2 DS tab q8h)</td><td>CrCl 15 – 30:<br>Administer 50% of recommended dose<br>PCP/Stenotrophomonas: 7.5 – 10 mg/kg/day TMP divided q8–12h</td><td>CrCl < 15:<br>Use is not recommended, but if needed for PCP/Stenotrophomonas: 5 – 10 mg/kg TMP q24h</td><td>2.5 – 5 mg/kg TMP q24h<br>PCP/Stenotrophomonas: 5 – 10 mg/kg TMP q24h<br>Dose daily, but after HD on HD days<br>alt: 5 – 20 mg/kg TMP post-HD only</td><td>5 – 10 mg/kg/day TMP divided q12h<br>PCP/ Stenotrophomonas: 15 mg/kg/day TMP divided q8–12h</td></tr>
<tr><td>Valacyclovir (PO)</td><td colspan="3"><table><tr><th></th><th>CrCl > 30</th><th>CrCl 10 – 30</th><th>< 10</th></tr><tr><td>VZV</td><td>CrCl >50: 1 g q8h<br>CrCl 30-50: 1 g q12h</td><td>1 g q24h</td><td>500 mg q24h</td></tr><tr><td>Genital herpes</td><td>Initial episode: 1 g q12h<br>Recurrent episode: 500 mg q12h</td><td>Initial episode: 1 g q24h<br>Recurrent: 500 mg q24h</td><td>Initial/recurrent episode: 500 mg q24h</td></tr><tr><td>Herpes labialis</td><td>CrCl >50: 2 g q12h x 2 doses<br>CrCl 30 – 50: 1 g q12h x 2 doses</td><td>500 mg q12h x 2 doses</td><td>500 mg x 1 dose</td></tr></table></td><td>500 mg q24h<br>Dose daily, but after HD on HD days</td><td>No data</td></tr>
<tr><td>Valganciclovir (PO)<br>Please refer to transplant protocols if applicable</td><td colspan="5"><table><tr><th></th><th>CrCl > 60</th><th>CrCl 40 – 59</th><th>CrCl 25 – 39</th><th>CrCl 10 – 24</th><th>CrCl < 10; IHD</th><th>CRRT</th></tr><tr><td>Induction (14-21 days)</td><td>900 mg q12h</td><td>450 mg q12h</td><td>450 mg q24h</td><td>450 mg q48h</td><td>200 mg 3x/week after HD only</td><td>No data</td></tr><tr><td>Maintenance/ prophylaxis</td><td>900 mg q24h</td><td>450 mg q24h</td><td>450 mg q48h</td><td>450 mg twice/week</td><td>100 mg 3x/week after HD only</td><td>No data</td></tr></table></td></tr>
<tr><td>Vancomycin (IV)<br>(Use actual body weight; refer to Vancomycin Guide : Appendix V for obesity dosing)</td><td colspan="3">Consider loading dose of 25 – 30 mg/kg (max 2.5 g) for severe infections and ICU<table><tr><th>CrCl (mL/min)</th><th>Dose & Frequency</th><th>Total daily dose range</th></tr><tr><td>> 90</td><td>15 mg/kg q8h to 15 – 20 mg/kg q12h</td><td>30 – 45 mg/kg/day</td></tr><tr><td>51 – 89</td><td>15 – 20 mg/kg q12h</td><td>30 – 40 mg/kg/day</td></tr><tr><td>30 – 50</td><td>15 mg/kg q12h to 20 mg/kg q24h</td><td>20 – 30 mg/kg/day</td></tr><tr><td>10 – 29</td><td>10 – 15 mg/kg q24h to 15 mg/kg q48h</td><td>7.5 – 15 mg/kg/day</td></tr><tr><td>< 10 or AKI</td><td>15 mg/kg x 1, then dose by level</td><td>N/A</td></tr></table>Goal trough 10 – 15 mcg/mL (cellulitis, skin/soft tissue infections)<br>Goal trough 15 – 20 mcg/mL (pneumonia, S. Aureus bacteremia, endocarditis, osteomyelitis)<br>Timing of levels: Draw trough < 30 minutes before 4th dose of new regimen. When SCr acutely rises, hold dose, restart when level < 15 – 20 mcg/mL<br>See appendix for complete guidelines</td><td>15 – 20 mg/kg x 1, then redose per algorithm<br>(see Appendix E of Vancomycin per Pharmacy Protocol)</td><td>15 – 20 mg/kg x 1, then 10 – 15 mg/kg q24h<br>Draw level prior to 3rd dose. Adjust to levels</td></tr>
</table>

| Drug | CrCl > 50 mL/min | CrCl 10 – 50 mL/min | CrCl < 10 mL/min | Intermittent Hemodialysis (IHD) | CRRT |
|---|---|---|---|---|---|
| **Vancomycin PO** | Poor systemic absorption- used for the treatment of *Clostridium difficile*-associated diarrhea<br>Mild/moderate/severe: 125 mg PO q6h<br>Severe complicated (CDI-related septic shock, ileus, toxic megacolon): 500 mg PO q6h | | | No change | No change |
| **Voriconazole (IV/PO)**<br>**(Dose by adjusted BW in obese)** | IV: 6 mg/kg IV q12h x 2, then 4 mg/kg IV q12h<br>PO: 400 mg PO q12h x 2, then 200 mg PO q12h | **IV→PO conversion 1:1 (round to nearest tablet size- available in 200 mg and 50 mg tablets)**<br>Caution with IV: accumulation of IV vehicle cyclodextran occurs. Consider PO if CrCl < 50 mL/min unless benefits justify risks of IV use.<br>Levels shown to have great degree of interpatient variability. Consider drawing a trough 4 – 7 days after new dose. | | | |

**Abbreviations**: SCr = serum creatinine; LD = loading dose; MU= million units; PNA = pneumonia; HD = hemodialysis; CAP = community acquired pneumonia; CRRT = continuous renal
replacement therapy; TMP = trimethoprim; PCP: pneumocystis jiroveci pneumonia; TB = tuberculosis; UF = ultrafiltration
**CRRT dosing**: doses listed are for CVVHDF and CVVHD modalities, which are the most common modes at SHC. Note that these are generally higher than doses used in CVVH.
LBW (men) = (1.10 x Weight(kg)) - 128 x (Weight$^2$/(100 x Height(m))$^2$) LBW (women) = (1.07 x Weight(kg)) - 148 x (Weight$^2$/(100 x Height(m))$^2$)
LBW online calculator: http://www.empr.com/medical-calculators/lean-body-weight-calculator/article/170219/

## Reference

Adapted from Stanford Healthcare antimicrobial dosing reference guide 2017

# Appendix VII, Antimicrobial Stewardship Metrics

| Metric | Definition | Sample Calculation | Advantages | Disadvantages |
|---|---|---|---|---|
| **Defined Daily Dose (DDD)** | The assumed average maintenance dose per day for a drug used for its main indication in adults as specified by the World Health Organization (WHO). (e.g. Levofloxacin = 500mg daily)<br><br>DDD is an attempt to estimate DOT (see below)<br><br>DDD are often standardized to 1000 patient days (DDD/1000 patient days) to allow comparison between hospitals or services of different sizes | Refer to the WHO-approved Defined Daily Dose values (see reference list below)<br><br>Rx: Levofloxacin 500mg po od x 7 days<br>DDD = (0.5g dose / 0.5g DDD) x 7d = 1 DDD x 7d = 7 DDD<br><br>Rx: Levofloxacin 750mg po od x 7 days<br>DDD = (0.75g dose / 0.5g DDD) x 7d = 1.5 DDD x 7d = 10.5 DDD<br><br>Rx: Levofloxacin 750mg po q48h x 7 days<br>DDD = ((0.75g * 24/48)/0.5gDDD) x 7d = (0.75) x 7d = 5.25 DDD | • Provides a method of measure to benchmark both within and between institutions and countries<br><br>• Can be calculated in the absence of computerized pharmacy records by using purchasing data | • Doses recommended by WHO as DDD may not be the currently recommended doses for optimization of activity of the antibiotic (e.g. Levofloxacin 750mg po daily = 1.5 DDD according to WHO and would result in a hospital having an apparently higher antibiotic utilization than an institution using 500mg po daily)<br><br>• Inaccurate in certain populations (e.g. renal impairment, pediatrics)<br><br>• For benchmarking between institutions or services, need to standardize the denominator of patient days, this information must be available to the institution or service<br><br>• When DDD is used as a measure of overall antibiotic use, rather than as a measure of a specific antibiotic, then benchmarking between institutions would need to account for formulary differences and similarly, if a hospital changed their formulary antibiotic this may change the overall antibiotic DDD, although use has not decreased (e.g. for either institutional formulary differences or change in formulary within an institution: cefotaxime 1g iv q8h = 0.75 DDD to ceftriaxone 1g q24h = 0.5 DDD) |
| **Days of Therapy (DOT)** | Any dose of an antibiotic that is received during a 24-hour period represents 1 DOT. The number of days that a patient receives an antimicrobial agent (regardless of dose). The DOT for a given patient on multiple antibiotics will be the sum of DOT for each antibiotic that the patient is receiving. DOT are often standardized to 1000 patient days (DOT/1000 patient days) to allow comparison between hospitals or services of different | Rx: Levofloxacin 500mg po od x 7 days<br>DOT = 1 DOT x 7d = 7 DOT<br><br>Rx: Levofloxacin 750mg po od x 7 days<br>DOT = 1 DOT x 7d = 7 DOT<br><br>Rx: Levofloxacin 750mg po od x 7 days + Vancomycin 1g iv q12h x 7 days | • Allows for multiple patient populations to be compared accurately<br><br>• Is NOT affected by change in dosing (e.g. Levofloxacin 500mg vs. 750 mg)<br><br>• **Is currently the most accurate and preferred measure of antibiotic use and is used by CDC and National Healthcare** | • For benchmarking between institutions or services need to standardize the denominator of patient days, this information must be available to the institution or service<br><br>• Requires computerized pharmacy records to obtain data. Manual determination of doses administered to the patient, although more precise is not practical |

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| | sizes. | DOT Levofloxacin = 1 DOT x 7d = 7 DOT<br>DOT Vancomycin = 1 DOT x 7d = 7 DOT<br>Total DOT = 14 DOT<br><br>Rx: Levofloxacin 750mg po q48h x 7days = 7 DOT | **Safety Network (formerly the Nosocomial Infection Surveillance** | • Favours those who use broad spectrum mono-therapy over in those who use narrow spectrum combination therapy. For example for Meropenem x 7 days = 7 DOTs, ceftriaxone + flagyl x 7 days = 14 DOTs<br><br>• Since 1 DOT is any dose of antibiotic received during a 24 hour period, the DOT for patients that receive a dosing interval >24 hours (e.g. renal failure patients) does not reflect patient exposure; it only reflects antibiotic administration |
| **Length of Therapy or Treatment Period (LOT)** | The number of days that a patient receives systemic antimicrobial agents, irrespective of the number of different drugs. Therefore, LOT will be lower than or equal to DOT because each antibiotic receives its own DOT. | Rx: Levofloxacin 500mg po od x 7d<br>LOT = 1 LOT x 7d = 7 LOT<br><br>Rx: Levofloxacin 750mg po od x 7d<br>LOT = 1 LOT x 7d = 7 LOT<br><br>Rx: Levofloxacin | Provides a more accurate assessment of treatment duration vs. DOT<br><br>The ratio of DOT/LOT may be useful as a benchmarking proxy for the frequency of combination antibiotic therapy vs. monotherapy. That is, ratio = 1, identifies monotherapy; ratio > 1 identifies combination therapy | Cannot be used to compare use of different drugs |

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| | | 750mg po od x 7d + Vancomycin 1g iv q12h x 7d<br>LOT = 1 LOT x 7d = 7 LOT<br><br>Rx: Levofloxacin 750mg po q48h x 7d<br>LOT = 1 LOT x 7d = 7 LOT | (e.g. ciprofloxacin x 7 days:<br>DOT = 1 DOT x 7d = 7 DOT<br>LOT = 1 LOT x 7d = 7 LOT<br>DOT/LOT = 1; therefore monotherapy<br><br>Ciprofloxacin + Flagyl x 7 days:<br>DOT = 2 DOT x 7d = 14 DOT<br>LOT = 1 LOT x 7d = 7 LOT<br>DOT/LOT = 2; therefore combination therapy | |
| **Antimicrobial Resistance Trends** | Number of patients with a specific drug-resistant organism divided by the total number of patients admitted to the ward, service or unit of interest [Morris ICHE 2012]. | Meropenem resistant *Pseudomonas aeruginosa* in critical care:<br><br>100 patients with meropenem resistant *P. aeruginosa* in 2009 with 500 patients admitted to critical care in 2009:<br>100/500 = 20%<br><br>60 patients with meropenem resistant *P. aeruginosa* in 2012 with 600 patients admitted to critical care in 2012:<br>60/600 = 10%<br><br>Therefore, the rate of meropenem resistant | • Enables quantification of resistance trends as a measure of the advantage of antimicrobial stewardship and infection prevention and control | • Decreases in resistance patterns lag behind decreases in antimicrobial use and therefore, should be assessed over the long term or extended periods (e.g. ≥ 1 year).<br><br>• Since multiple interventions typically take place concurrently it is difficult to attribute observed changes specifically to antimicrobial use<br><br>• Requires the ability of microbiology or another data base to track susceptibility and a data base to track patient admission to ward, service or unit of interest |

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| | | P. aeruginosa was reduced from 20% in 2009 to 10% in 2012 | | |
| | Antibiogram based on unique isolates* and susceptibility to given antibiotics | Number of unique isolates resistant and susceptible to a given antibiotic:<br><br>*P. aeruginosa* in blood in critical care / number of unique blood cultures that are resistant to meropenem | • Easier to do than a per patient approach, since the information can be obtained directly from a microbiology database without a patient denominator | • Less clinically important than number of episodes of AROs per patient |
| ***C. difficile* rate** | Number of patients with documented *C. difficile* infection divided by the number of patients admitted to the ward, service or unit of interest over a specified time period | 2009: 75 cases *C. difficile* and 500 patients admitted to critical care in 2009 = 75/500 = 15%<br><br>2011: 43 cases *C. difficile* and 450 patients admitted to critical care over in 2011 = 43/450 = 9.5%<br><br>Reduction in *C. difficile* = (15 – 9.5)/15 = 5.5/15 = 37% reduction in *C. difficile* in 2011 compared to 2009 | • *C. difficile* is a publicly reported infection that all institutions must comply with reporting. Therefore, there is a lot of pressure on institutions from senior administration to *reduce C. difficile* rates.<br><br>• This could also be used as a measureable Adverse Drug Reaction (ADR) for antibiotic associated –*C. difficile* - nosocomial (confirmed) or antibiotic associated diarrhea (unconfirmed) | |
| **Antimicrobial Expenditures** | Antimicrobial costs can be based on:<br>acquisition (purchased), dispensed or administered over a defined time period<br><br>Costs can be expressed as absolute dollar value, percent of total (purchased, dispensed or administered ) and/or per patient-days<br><br>The selected method of costing antimicrobials can be tracked monthly and annually hospital wide, for specific clinical services (e.g. ICU), classes of antimicrobials (e.g. fluoroquinolones), individual drugs (e.g. linezolid), or types of infections/indications (e.g. ventilator associated pneumonia) | 2009 Pharmacy drug budget of $3,000,000 Antimicrobial acquisition costs $750,000 (25% of budget)<br><br>Cost savings (percent reduction in antimicrobial costs):<br><br>a) overall antibiotic acquisition costs<br><br>2010 $750,000<br>2011 $675,000<br>Absolute decrease of $75,000, equals 10% reduction<br><br>b) ICU antibiotic acquisition costs<br><br>2010 $100,000 (patient days = 2000, $50/patient-day)<br>2011 $75,000 (patient days = 2000, $37.50/patient-day)<br>Absolute decrease of $25,000, equivalent to a reduction of $12.50/patient-day | • Expenditures are easily understood by and relevant to administrators<br><br>• May be viewed favourably in offsetting costs of stewardship program<br><br>• Relatively easy to determine acquisition costs from purchasing records<br><br>• Costs adjusted by patient days for comparisons between clinical services may help to broadly identify potential areas for stewardship initiatives | • Purchased and dispensed costs are surrogate markers for administered costs (what the patient actually receives)<br><br>• Difficulty in retrieving data and accuracy of actual consumption is greatest for administered, followed by dispensed and then purchased costs<br><br>• Acquisition costs can fluctuate with contracts/suppliers, generics and with patient volume (patient-days to normalize), and therefore calculated cost reductions will not be reflective of stewardship interventions<br><br>• Dispensed costs may not account for "returns" to pharmacy<br><br>• Medication Administration Record reviews to obtain administered drug data is time consuming and not easily performed (bar coding is not generally available) |

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| | | | | • It may be difficult to retrieve antimicrobial costs for specific clinical services or wards depending on the capability of the pharmacy computer system<br><br>• Cannot generally retrieve antimicrobial costs for specific infections/indications from the pharmacy system |
| **Grams of antimicrobials** | Grams of antimicrobial based on: acquisition (purchased), dispensed or administered over a defined time period<br><br>-serves as an integral step to determining DDD | | • Relatively easy to determine grams of antimicrobial from purchasing records<br><br>• Grams adjusted by patient days for comparisons between clinical services may help to broadly identify potential areas for stewardship initiatives<br><br>• Grams of use is not affected by changes in price of antimicrobials over time and therefore, may be a more accurate reflection of the impact of antimicrobial stewardship initiatives | • Provides a very rough approximation of antimicrobial use |

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| | | | compared to before and after analyses comparing cost | |
| **Interventions** | Tally of the number and type of interventions made and accepted<br><br>Potential types of interventions are listed in the sample calculation and the notes below | 1000 antimicrobial orders were reviewed by the stewardship team in 2011 and recommendations were made for 750 (75%)<br><br>The overall acceptance rate was 650/750 (87%)<br><br>The types of interventions made and their acceptance rates were:<br>Dose optimization n= 190/200 (95%)<br>Escalation of therapy n=45/50 (90%)<br>Discontinuation of therapy n=165/200 (83%)<br>De-escalation of therapy n=250/300 (83%) | • Cost savings/avoidance (in concert with improved patient outcomes – e.g. reduced *C. difficile*) with documentation of accepted interventions, lends support to the changes being a result of antimicrobial stewardship incentives and will be viewed favourably by administrators in offsetting costs of stewardship program | |

| | | | | |
|---|---|---|---|---|
| | | compared to 2009 | | |
| **Antimicrobial Expenditures** | Antimicrobial costs can be based on:<br>acquisition (purchased), dispensed or<br>administered over a defined time period<br><br>Costs can be expressed as absolute dollar value, percent of total (purchased, dispensed or administered ) and/or per patient-days<br><br>The selected method of costing antimicrobials can be tracked monthly and annually hospital wide, for specific clinical services (e.g. ICU), classes of antimicrobials (e.g. fluoroquinolones), individual drugs (e.g. linezolid), or types of infections/indications (e.g. ventilator associated pneumonia) | 2009 Pharmacy drug budget of $3,000,000 Antimicrobial acquisition costs $750,000 (25% of budget)<br><br>Cost savings (percent reduction in antimicrobial costs):<br><br>a) overall antibiotic acquisition costs<br><br>2010 $750,000<br>2011 $675,000<br>Absolute decrease of $75,000, equals 10% reduction<br><br>b) ICU antibiotic acquisition costs<br><br>2010 $100,000 (patient days = 2000, $50/patient-day)<br>2011 $75,000 (patient days = 2000, $37.50/patient-day)<br>Absolute decrease of $25,000, equivalent to a reduction of $12.50/patient-day | • Expenditures are easily understood by and relevant to administrators<br><br>• May be viewed favourably in offsetting costs of stewardship program<br><br>• Relatively easy to determine acquisition costs from purchasing records<br><br>• Costs adjusted by patient days for comparisons between clinical services may help to broadly identify potential areas for stewardship initiatives | • Purchased and dispensed costs are surrogate markers for administered costs (what the patient actually receives)<br><br>• Difficulty in retrieving data and accuracy of actual consumption is greatest for administered, followed by dispensed and then purchased costs<br><br>• Acquisition costs can fluctuate with contracts/suppliers, generics and with patient volume (patient-days to normalize), and therefore calculated cost reductions will not be reflective of stewardship interventions<br><br>• Dispensed costs may not account for "returns" to pharmacy<br><br>• Medication Administration Record reviews to obtain administered drug data is time consuming and not easily performed (bar coding is not generally available) |

**Reference**
**Public Health Ontario, metrics and evaluation**

# Appendix VIII, Colistin Dosing

- Colistin should be combined with carbapenem. Please see below for doses recommendations (Appendix I)
- Infectious Disease approval is required for both colistin and carbapenems.

| | CrCl (mL/min) | Dose | Frequency | Comments |
|---|---|---|---|---|
| **Suspected infection** | **All patients receive LD = 9 million units**<br>➢ **Maintenance dose should be given 12 hr after LD** | | | |
| | >80 | 5.5 million units | Every 12 hr | **Administer IV LD over 1-2 hr** |
| | 60-80 | 4.5 million units | | |
| | 30-59 | 3.5 million units | | |
| | 10-29 | 2.5 million units | | |
| | <10 | 2 million units | | |

- **Dosing: Renal Replacement Therapy (Adults):**

| | CrCl (mL/min) | Dose | Frequency | Comments |
|---|---|---|---|---|
| **Suspected infection** | **All patients receive LD = 9 million units**<br>➢ **Maintenance dose should be given 12 hr after LD** | | | |
| | Hemodialysis (HD) | Non-dialysis day<br>2 million | Every 12 hr | ≈On dialysis days:<br>Supplemental dose of **1.5 million** after each 3-4 h episode of dialysis |
| | | On dialysis days≈<br>4 million | Every 24 hr | |

| | CrCl (mL/min) | Dose | Frequency | Comments |
|---|---|---|---|---|
| **Suspected infection** | **All patients receive LD = 9 million units**<br>➢ **Maintenance dose should be given after LD according to the frequency** | | | |
| | Prolonged Intermittent CRRT (4-12 hr) | Non-dialysis day<br>2 million | Every 12 hr | If CRRT is interrupted:<br>- After ≤ 50% of the CRRT scheduled time, **NO supplement dose**<br>- After >50% of the CRRT scheduled time, **GIVE 1.5 Million as supplement dose**<br>Dose based on CrCl (mL/min) < 10ml/min **2 Million every 12hr** |
| | | On dialysis days<br>a) 2.8 million of 4 h episode of dialysis<br>b) 3 million of 5 h episode of dialysis<br>c) 3.2 million of 6 h episode of dialysis<br>d) 3.4 million of 7 h episode of dialysis<br>e) 3.6 million of 8 h episode of dialysis<br>f) 3.8 million of 9 h episode of dialysis<br>g) 4 million of 10 h episode of dialysis<br>h) 4.2 million of 11 h episode of dialysis<br>i) 4.4 million of 12 h episode of dialysis | | |
| | CRRT (24hrs) | 5 million units | Every 8 hr | |
| | Peritoneal Dialysis | 5 million units | Every 24 hr | |

- **Dosing: Renal Replacement Therapy (Adults):**

| Pediatric dosing | | | | |
|---|---|---|---|---|
| | **Weight** | **Dose** | **Frequency** | **Comments** |
| **Susceptible Infections** | ≤ 40kg | 75,000-150,000 Units/kg/**day** | Divided every 8 – 12 hr | **Loading dose not required** *For any renal impairment consult the clinical pharmacist |
| | ≥ 40kg | 4.5 million units | Every 12 hr | |

*Consider urine output, elevations >50% from baseline Serum Creatinine, and Estimated GFR

| Inhalation including Cystic Fibrosis | | | | |
|---|---|---|---|---|
| | **Age** | **Dose** | **Frequency** | **Comments** |
| **Inhalation** | Adults, adolescents and children ≥ 2yrs | 1-2 million units (**Max:** 6 million units/day) | Every 12 hr **or** Every 8 hr | • Use inhalation solution promptly after reconstitution; **Do not use after 24 hr**<br>• Pre-medicate with salbutamol |
| | Children < 2 years | 0.5-1 Million units (**Max:** 2 million units/day) | | |
| **CSF Sterilization** | | | | |
| | **Route** | **Dose** | **Frequency** | **Comments** |
| **CSF Sterilization** | Intrathecal | 150,000-300,000 units/day | Every 24 hr | • Dose should be diluted in 1-2 mL of normal saline<br>• Remove equal volume of CSF then<br>• Give colistin either:<br>○ **Intrathecally**: Via lumbar puncture<br>**OR**<br>○ **Intraventricularly**: Via an external ventricular drain (EVD), clamp for 1 hr & release |
| | Intraventricular | 60,000-300,000 units/day | Every 24 hr | |

## Carbapenems Dosing guidelines in Adult patients (Synergistic Combination of Carbapenems & Colistin)

- Before starting meropenem **extended infusion** ensure that:
  - Y-site compatibilities are checked before administering concurrent medications
  - Room temperature does not exceed 25°C
  - Flush the IV line with 20 mL of Normal Saline before and after infusing meropenem
- For *Acinetobacter baumannii*, meropenem was more synergistic than imipenem
- For *Pseudomonas aeruginosa*, imipenem was more synergistic than meropenem

| Dosing Recommendations for Extended Meropenem Infuse Over 3 hours | | |
|---|---|---|
| **CrCl (mL/min)** | **Dose** | **Frequency** |
| > 50 | 2 g | Every 8 hr |
| 30-50 | 2 g | Every 12 hr |
| < 30 | Infused over 30 minutes | |
| Intermittent CRRT (≤ 12 hr)/ Hemodialysis (HD) | | |
| CRRT (24) | 2 g | Every 8 hr |

| Dosing Recommendations for Intermittent Meropenem Infuse Over 30 Minutes | | |
|---|---|---|
| **CrCl (mL/min)** | **Dose** | **Frequency** |
| ≥ 51 | 2 g | Every 8 hr |
| 26-50 | 2 g | Every 12 hr |
| < 26 | 1 g | Every 12 hr |
| Intermittent CRRT (≤ 12 hr)/ Hemodialysis (HD) | 1-2 g | Every 24 hr (On dialysis days give post-HD) |
| CRRT (24) | 2 g | Every 8 hr |

| Dosing Recommendations for Imipenem | | |
|---|---|---|
| **CrCl (mL/min)** | **Dose** | **Frequency** |
| > 50 | 500 mg | Every 6 hr |
| 20-50 | 500 mg | Every 8 hr |
| < 20 | 250 mg | Every 12 hr |
| Intermittent CRRT (≤ 12 hr)/ Hemodialysis (HD) | 500 mg | Every 12 hr |
| CRRT (24) | 500 mg | Every 6 hr |

## Monitoring Parameters

- **Serum Creatinine and BUN closely**
- **Signs of Neurotoxicity:** neuromuscular blockade that can lead to respiratory failure or difficulty weaning, seizure, change in mental status up to coma, flaccid paralysis, facial paraesthesia
- **Risk Factors for Neurotoxicity:** Myasthenia gravis, hypomagnesaemia, hypocalcemia, concurrent administration with aminoglycosides or neuromuscular blocking agents
- Neurotoxicity is typically reversible upon dose reduction or discontinuation

**Note:**

- This guideline will be updated periodically to reflect good practice and lessons learned from earlier reviews
- Colistin doses may vary based on patient's condition, weight and indication

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